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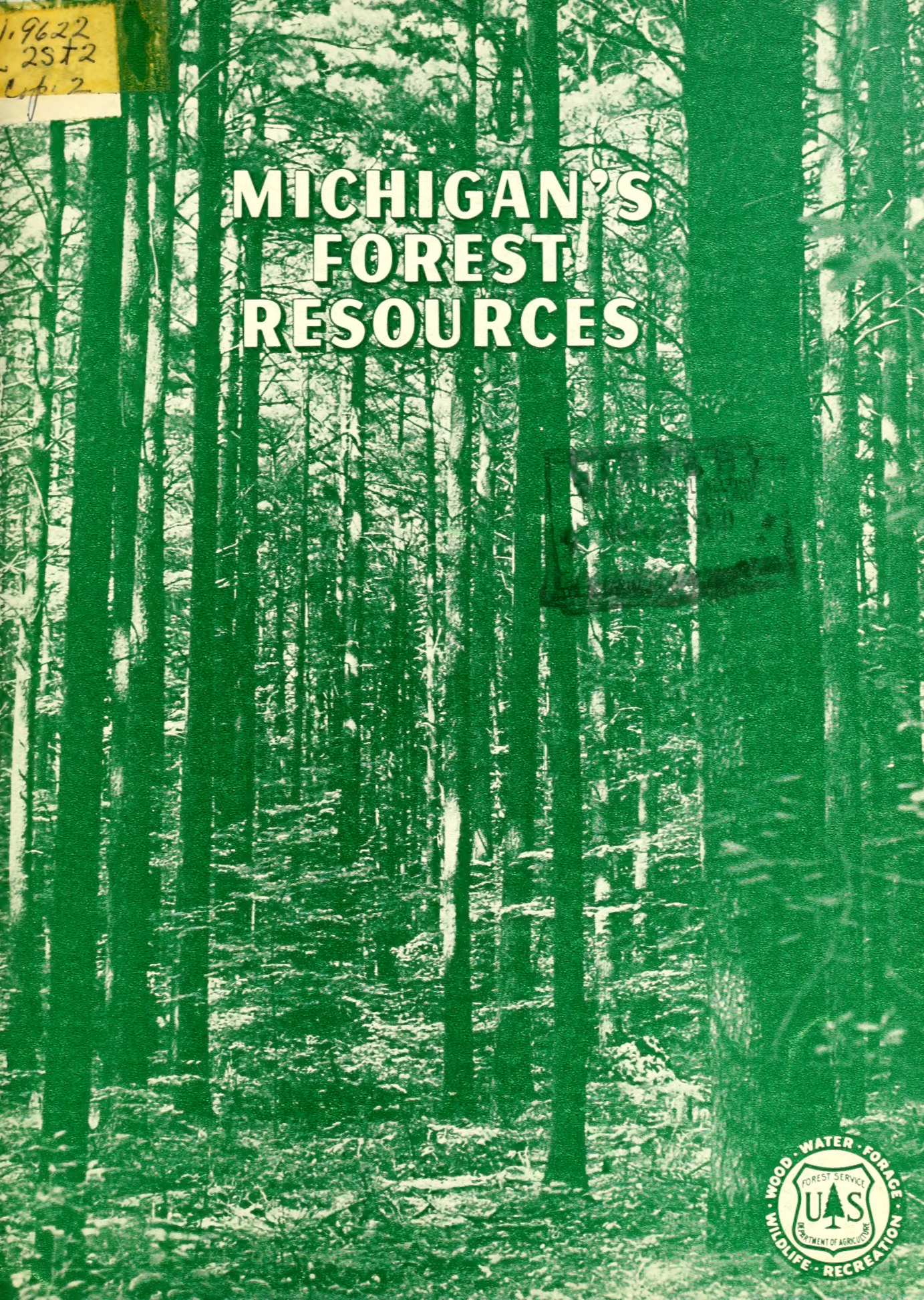
MICHIGAN'S FOREST RESOURCES



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Cover picture.—Second-growth white pine in northern Lower Michigan. This type was the most desired forest type in original forests. Many of these areas were converted by logging and fires to hardwood types, but some restocked naturally to form stands similar to the one above. (Photo courtesy of Consumers Power Company.)

Michigan's Forest Resources

by

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FOREST SERVICE U. S. DEPARTMENT OF AGRICULTURE
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The Changing Forest

Timber is big business in Michigan. It supplies jobs and income to thousands of people, safeguards our water and soil, provides food and cover for game, and is the setting for countless city-weary vacationists (fig. 1). Its effects are far-reaching. Raw materials exported from Michigan's forests to other States sustain industries and provide jobs. Finished products contribute beauty, satisfaction, and utility to individuals throughout the nation and in foreign countries.

Forests are not static. They are ever-changing plant communities. In addition to the natural cycles of life, growth, and death of individuals, different types of plants follow each other in response to actions of man, fire, and wind (fig. 2).

Grassy areas become brush-covered, and the brush is eliminated in competition with aspen or jack pine (fig. 3). Finally, an equilibrium is reached called the climax forest. This might be, for example, a beech-birch-maple complex, or spruce-fir—depending on the area involved.

In Michigan, change in the forest is of critical importance since vast areas are in a stage between the denuded areas of the old-time logging era and the natural climax forest.

From White Pine to Aspen

The opening of the Erie Canal in the early 1800's gave impetus to westward migration. Settlers came looking for the new life that the rich farming soils of the Midwest promised. As they progressed, forests were cut down to make farming possible and to provide warmth and shelter. New towns sprang up across Michigan and west over the plains; people demanded more and more lumber. Gradually the Eastern forests were depleted of the then most valuable lumber—white pine—and Michigan came into prominence as a white pine producer. In the late 1800's Michigan was the largest supplier of this lumber. But forests reproduce slowly, and logging was not conducted in a manner that permitted renewal of Michigan's timber. As a result, by 1920 production of white pine was only a fraction of its peak. Repeated fires, running unchecked, destroyed young growth and depleted the soil. Then aspen, jack pine, and scrub oak came in on vast areas of forest land.

	Estimated original (million acres)	1935 Survey (million acres)	1955 Survey (million acres)
Forest type areas:			
Pine	10.0	1.0	1.6
Spruce-fir	4.5	1.4	.7
Coniferous swamp	3.5	1.3	1.4
Northern hardwoods	9.0	4.6	4.7
Oak-hickory	5.0	1.3	1.8
Lowland hardwoods	3.0	.7	1.0
Aspen	—	5.0	4.8
Other[1]	.5	3.8	3.7
Total	35.5	19.1	19.7

[1] Originally this was scrub forest land; in 1935 and 1955 it consisted of nonproductive, reserved forest land and grass-brush.

These changes, however, did not destroy the usefulness of the forest. Many species once regarded as "weeds" were found to be of value for paper making

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FIGURE 2.—*Aspen and birch, which replaced the pine after logging and burning, are now being superseded by pine.*

FIGURE 1.—*Forests produce wood for Michigan's industries and provide recreation for its residents and visitors. (Photo courtesy of Michigan Department of Conservation.)*

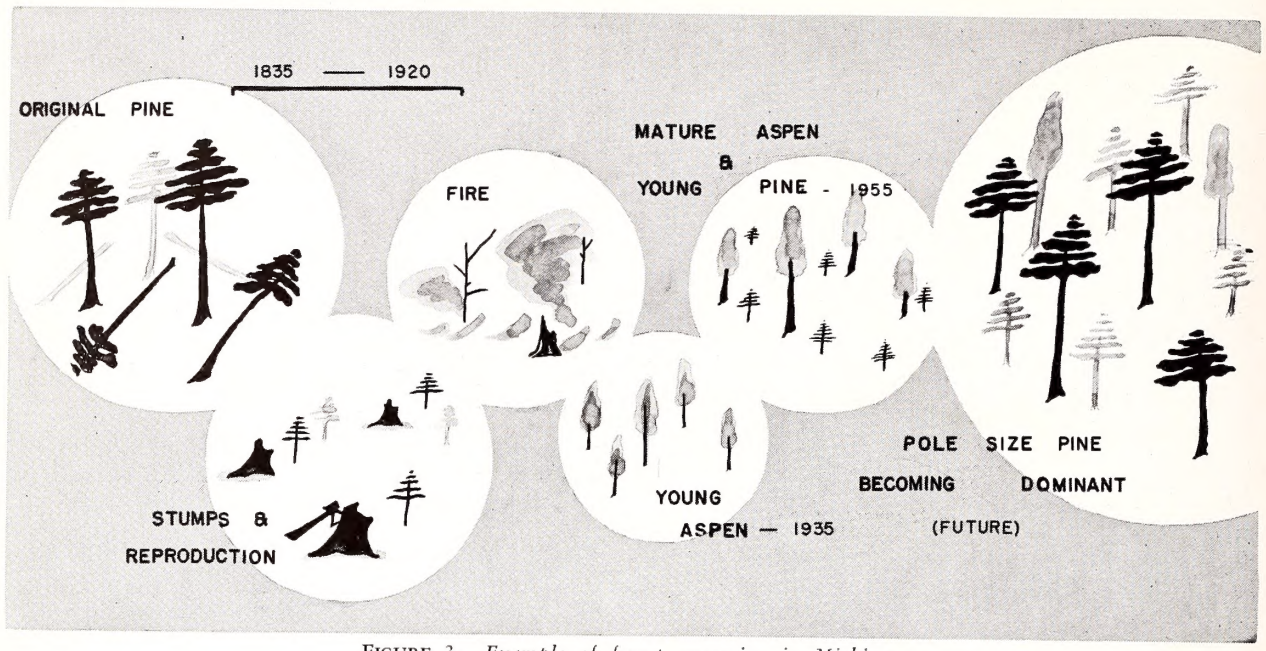

FIGURE 3.—*Example of forest succession in Michigan.*

and other uses. Thousands of cords of aspen are now harvested for Michigan's thriving pulp and paper industry.

1935-55, Type Acreages Change

A comparison of species group acreages shows significant changes between 1935 and 1955. Pine increased by over a half million acres. Reforestation probably accounted for much of this although natural restocking was a factor. Oak-hickory and lowland hardwoods also expanded; together they covered an additional four-fifths of a million acres during the last two decades.

Although the pine types increased, other softwoods did not fare so well. Black spruce, spruce-fir, and tamarack all were reduced in acreage. Cedar increased enough to offset the reductions in black spruce and tamarack, giving swamp conifers a slight net gain. The situation is most striking in the spruce-fir type, which decreased some 700,000 acres.

Three and a half million acres of nonstocked forest land in 1935 was reduced to a little more than three million acres by 1955. Reforestation and fire protection (which enabled deforested and abandoned farm land to restock) apparently are the primary causes. Although some of the nonstocked land will be uneconomical for planting and some is needed for game management, the job of planting these idle acres is a big one.

1935-55, Stands "Thickening Up"

One of the most striking changes is the increase in stocking of seedling and sapling stands. In 1935 half the stands were poorly stocked; now only about 20 percent are deficient in number of trees. Also, the total area of seedling and sapling stands has decreased by nearly a fourth while the area of poletimber has increased.

	1935	1955
Area with 3 cords or more per acre:	Percent of area (6.5 million acres)	Percent of area (9.1 million acres)
Sawtimber stands:		
Softwood types	7	4
Hardwood types	40	30
Poletimber stands:		
Softwood types	18	15
Hardwood types	35	51
Total	100	100
Young stands:	(8.8 million acres)	(6.8 million acres)
Medium and well stocked seedlings and saplings	46	77
Poorly stocked seedlings and saplings	54	23
Total	100	100

Much of the increase in poletimber stands has occurred in hardwood species. Their proportion of the forest has changed from about one-third in 1935 to half in 1955. Softwood pole stands, although adding to their acreage slightly, have not increased in proportion to hardwoods.

Sawtimber stands have decreased relative to other

changes in the forest. Formerly they covered half of the acreage of merchantable timber; now they occupy little more than a third.

1935-55, Timber Volumes Show Little Change

Hardwood volumes have risen because of increases in aspen, elm, ash, red maple, and similar species, but the valuable northern hardwood volumes have decreased. Generally, softwoods have dipped both in sawtimber and poletimber volume although pine has shown significant increases. However, increases in growth and acreage in many of these species groups promise higher volumes in the future, assuming reasonable cutting practices.

	1935 Survey (billion cu. ft.)	1955 Survey (billion cu. ft.)
Growing stock volume:[1]		
Softwoods	3.6	2.6
Northern hardwoods	3.7	2.4
Other hardwoods	3.1	5.7
	(Billion bd. ft.)	(Billion bd. ft.)
Sawtimber volume:		
Softwood	9.7	6.4
Hardwood	16.6	17.4

[1] This and other Forest Survey terms are defined in the appendix.

1935-55, Growth Jumps

Growth has increased. Both growing stock and sawtimber growth are larger now than in 1935. Only aspen shows a total growth decline and this is slight. Hardwoods such as elm, ash, and soft maple have shown the largest total gains, although other species groups have greater percentage increases.

Net annual sawtimber growth has doubled, primarily for two reasons: the harvesting of mature stands which contributed little growth, and the movement of pole-sized trees into the sawtimber class. Again, "other" hardwoods (hardwoods other than aspen and northern hardwoods) have the largest portion of the increase.

	1935 (million cu. ft.)	1955 (million cu. ft.)
Annual growth of growing stock:		
Pine	20	51
Other softwoods	44	83
Northern hardwoods	54	75
Aspen-cottonwood	112	109
Other hardwoods	87	175
Total	317	493
	(Million bd. ft.)	(Million bd. ft.)
Annual growth of sawtimber:		
Pine	62	168
Other softwoods	93	200
Northern hardwoods	156	163
Aspen-cottonwood	36	149
Other hardwoods	145	459
Total	492	1,139

Mortality Losses High

In 1955 mortality losses of 112 million cubic feet were equivalent to 23 percent of the total net annual growth. Chief among the destructive agents were insects and disease. Fire, once the major agent, caused less than 1 percent of the mortality.

Large Volumes of Cull and Poor-Quality Trees

Over half of the hardwood sawtimber volume is suitable only for ties, timbers, and local-use lumber. Also present are 1.6 billion cubic feet of wood in cull trees.

Since a considerable portion of the low-grade trees are low grade because of their small size, they will grow to furnish high-grade material in 10 or 20 years. However, many of the poor-quality trees are large, mature trees of poor form with defects that will never become better.

Pine, Northern Hardwoods Show Unequal Stand-Size Classes

For sustained timber yields in Michigan, the forests should be composed of all ages and stages of development from seedlings to mature timber in such proportions that when one group of mature trees is harvested another is ready to take its place (fig. 4). Most types have fairly well balanced size-class distribution. However, considerable adjustment is necessary within certain types, especially the northern hardwoods and some of the softwoods. The pine types have a large portion of their area in seedling and sapling stands. Red pine, for example, had a third of its area covered by restocking-size trees in 1935; the same size now accounts for over two-thirds of the red pine area. This is primarily due to reforestation over the past years. Under continued management and protection, these plantations can reach sizes and stocking levels needed to produce high yields.

For the pine types this means that cutting should be delayed somewhat in the older age classes to allow the correct proportion of reproduction acreage to reach merchantable sizes. Thus, allowable cut is somewhat lower than would be possible if all ages and sizes were equally represented.

Allowable cut in the northern hardwood type is also considerably below that possible if age classes were balanced. However, an additional amount of volume could be cut by making needed improvement cuts and thinnings.

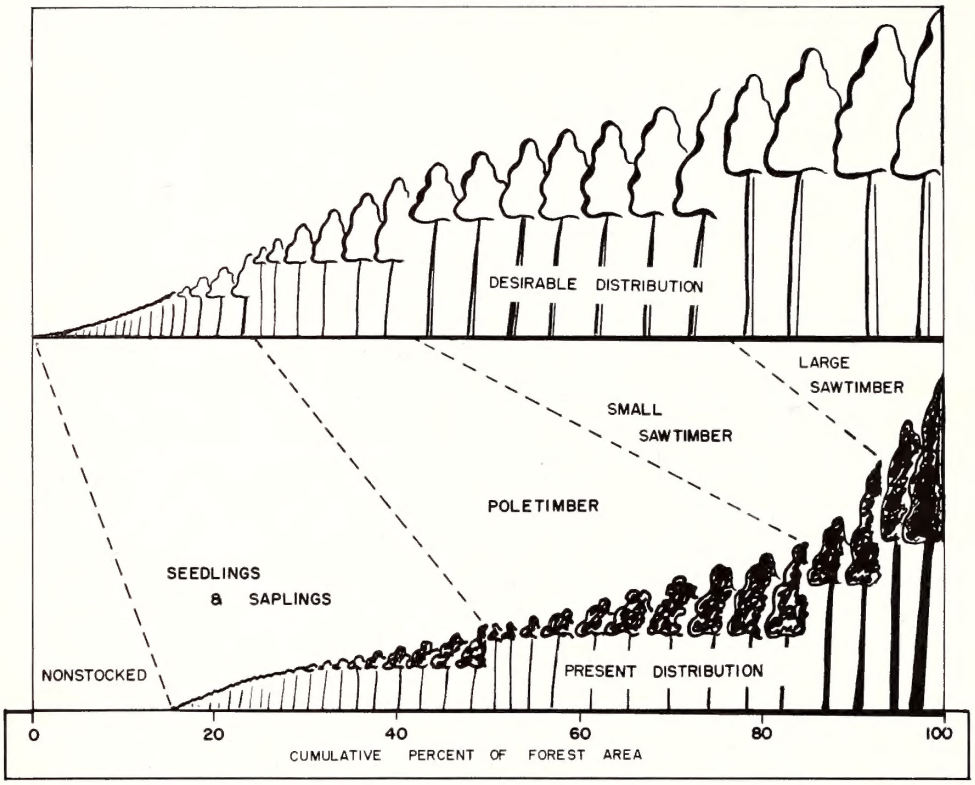

FIGURE 4. — *Comparison of desirable and present distribution of size classes in Michigan. The "desirable" stand-size distribution is generalized for all Michigan timber but does not apply to forest types that are not customarily managed for sawtimber.*

How Much Can Be Cut?

The relationships between species, volumes, areas, growth, mortality, and size classes indicate forests' ability to produce relatively constant amounts of timber. In Michigan, forest productivity is generally under that which is possible. As a result, in many species groups, desirable harvests are calculated at less than timber growth. Desirable harvest equals maximum harvest *only* if all segments of the forest are in balance.

The total allowable annual cut of all timber in Michigan is about 3.5 million cords, including 757 million board feet of sawtimber. Much of this is in hardwood species such as aspen, maple, elm, and oak.

Comparing the actual cut in 1954 with the annual allowable cut reveals some surpluses and some deficits. Northern hardwoods are generally being overcut, with the emphasis on two of the type's most valuable components—yellow birch and sugar maple. Much of this overcut is occurring in western Upper Michigan. Similarly, in the same district, spruce and balsam fir are being overcut.

Some surpluses are available. The sharpest differences between allowable and actual cut are in hardwood species such as oak, aspen, paper birch, and soft maple; although a large part of this surplus is in small trees, much is suitable for pulping. The greatest portion of sawtimber surpluses (annually 212 million board feet) is in these species also.

Excess volume in pulpwood species is mainly in aspen and jack pine, with aspen providing three-fourths of the extra 484,000 cords available annually.

The Forest Resource

Forest Lands

More Than Half of Michigan Is Forest Land

Nearly 20 million of Michigan's 36 million acres are forested (appendix table 1). More than 97 percent of this is suitable for timber production and therefore is classed as commercial forest land. In the noncommercial land category are an additional 338,000 acres of productive forest withdrawn from timber cutting and used for parks and recreational reserves and 240,000 forested acres that are unproductive because of adverse site conditions.

Northern Area Heavily Forested

Because of differences in land use and forest conditions Michigan was divided into four districts (fig. 5). The western boundaries of Menominee, Delta, and Alger Counties serve as the dividing line between the eastern and western Upper Peninsula districts. A line from Muskegon to Saginaw roughly marks the boundaries of the northern and southern Lower Peninsula districts.

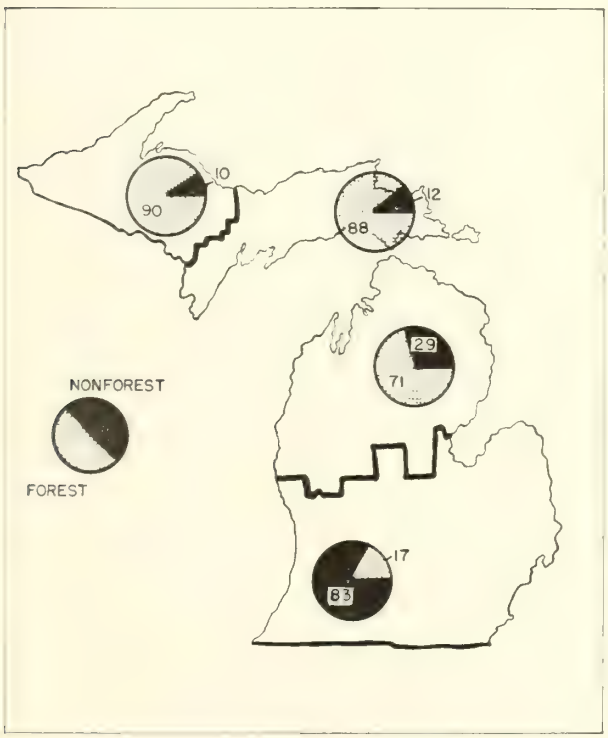

FIGURE 5.—*Proportion of forest and nonforest land for the major forest survey divisions of the State.*

Nearly nine-tenths of the Upper Peninsula is forest land. Originally extensive forests of northern hardwoods, pine, spruce-fir, and swamp conifers grew there, and these same forest types are still very much in evidence today (fig. 6). But following logging and fires, aspen and inferior tree species became dominant on some of the land or it remained as grass-brush. About 3 million acres remain in northern hardwoods; although much is second-growth forest, the species composition is similar to that of the original forest.

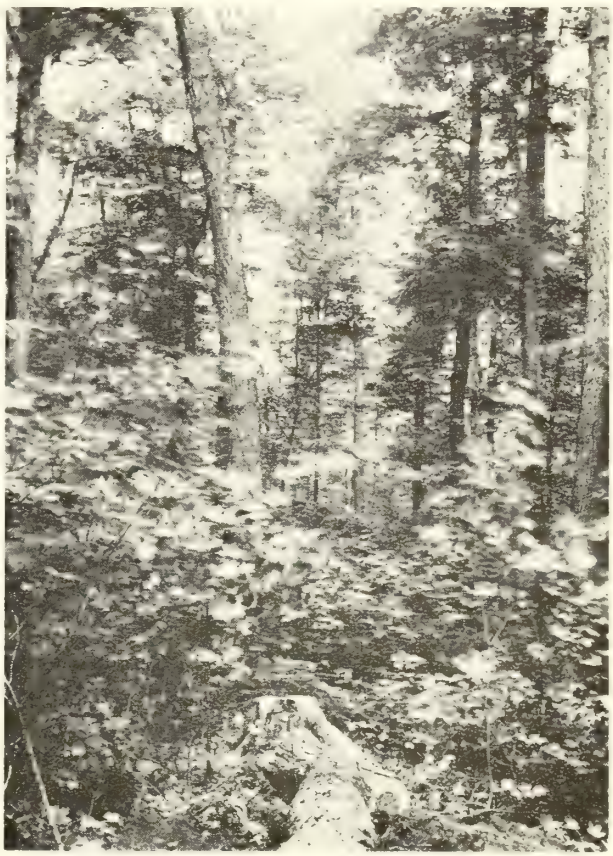

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FIGURE 6.—*A stand of old-growth northern hardwoods in the Upper Peninsula. These stands are important to Michigan's wood-using industries because of the quality of timber they contain.*

The northern Lower Michigan district is 70 percent forested. The original forests were similar to those of

the Upper Peninsula but contained more pine. This area, part of the "great Michigan pinery," was once noted for its high-quality white pine. Remnants of virgin white pine stands remain as isolated tracts, mostly in public parks or recreational areas. Although the district still has about a million acres of pine types, the greater part of this is covered with jack pine. While these stands are not as imposing as the virgin white pine, they form the basis for a significant part of Michigan's pulpwood production.

Southern Lower Michigan Mostly Farm Woods

The 37 counties in the southern half of the Lower Peninsula are primarily an agricultural and industrial area. Only 17 percent is forested, and most of this is in farm woodlots (fig. 7). The district contains, however, the largest area of sawtimber stands. Hardwood forests such as oak, maple, ash, and elm are the rule, with softwoods covering only a minor part of the forest area.

One Acre in Six Is Sawtimber

Of every 6 acres of commercial forest land in the State, 1 acre is in sawtimber stands, 2 acres are poletimber, 2 acres are seedlings and saplings, and 1 acre is nonstocked. Four-fifths of the seedling and sapling stands are medium- to well-stocked; the remaining fifth is poorly stocked:

	Thousand acres	Percent
Stand-size class:		
Large sawtimber	1,165	6
Small sawtimber	1,844	10
Poletimber	6,119	32
Seedling and sapling:		
Medium- to well-stocked	5,323	28
Poorly stocked	1,522	8
Nonstocked	3,148	16
All stands	19,121	100

Almost 40 percent of the sawtimber area is classed as large sawtimber. Sawtimber stands are fairly equally distributed, although southern Lower Michigan has a

FIGURE 7. — *Farm woodlot maples in southern Lower Michigan being "tapped" for sap. Although generally neglected, these woodlots are capable of producing high-quality veneer and saw logs, as well as many home-use products. (Photo courtesy of Michigan Department of Conservation.)*

somewhat greater area than other districts (appendix table 2). Northern Lower Michigan has the largest area of poletimber stands.

Hardwoods Occupy Over Three-Fifths of the Forest Land

The extensive stands of softwoods that once covered Michigan have been replaced to a large extent by hardwoods.[1] Aspen, which in the original forest occurred only in small openings and occupied only a minute portion of the total, is now the largest forest type (appendix table 3). The northern hardwood type is the second in size. Together they cover almost one-half of the forest area (fig. 8).

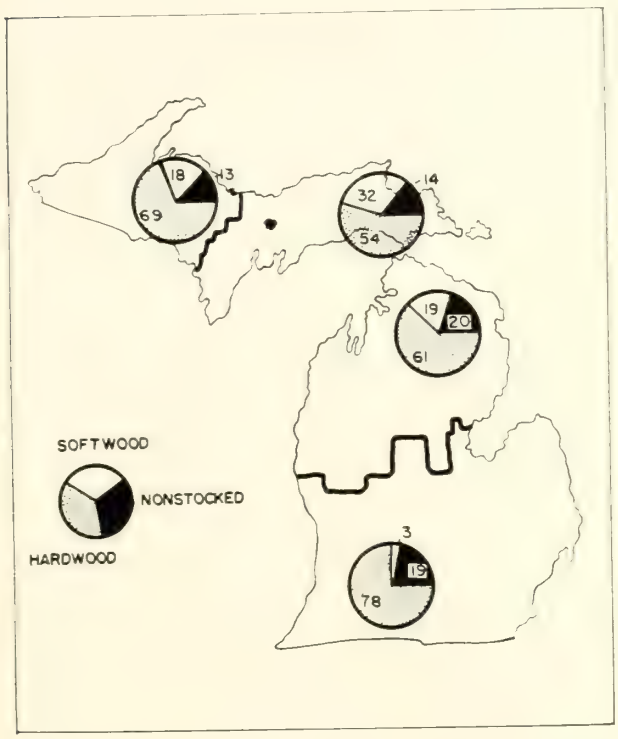

FIGURE 8.—*Proportions of forest land in hardwood and softwood forest types and in nonstocked condition, by Forest Survey district, Michigan.*

Hardwoods are plentiful throughout the State. The northern hardwood type of over 4½ million acres is largely in western Upper Michigan, although the other two northern districts support substantial acreages. Aspen-birch is also found mainly in the Upper and northern Lower Peninsulas with the latter district having the largest area. Many of the aspen stands have an understory of conifers; in these stands management can speed the natural conversion to the more valuable conifer types, although some industries now depend heavily on aspen and will wish to perpetuate it on good aspen sites.

Acreages in other hardwood types such as oak-hickory and elm-ash-cottonwood are primarily in Lower Michigan. In the Upper Peninsula elm and ash grow to a small extent along rivers on moist sites but are of minor importance.

The hardwood types, excluding aspen, have only 34 percent of their area in sawtimber stands.

Softwoods Primarily in Northern Areas

Softwood types account for 25 percent of the forest area of the Upper Peninsula and 19 percent in northern Lower Michigan; elsewhere they are of minor importance.

The Upper Peninsula's largest softwood type is cedar. The next largest is spruce-fir (fig. 9). Here the combined pine types make up slightly over one-fourth of the softwood area.

Northern Lower Michigan's largest softwood type is jack pine. All pine types together account for over two-thirds of the softwood area here (fig. 10).

Of the conifer forest types 91 percent are in stands smaller than sawtimber (appendix table 4).

Nonstocked Land a Problem

Nonstocked forest land, of which 2,100,000 acres are upland brush and grass and 1,000,000 acres are lowland brush, account for 16 percent of the forest land. Putting this nonstocked land back into timber production is one of the more serious problems. Much of the lowland presents difficult planting problems because of its swampy nature and heavy brush cover. The more easily planted upland grass and brush areas are being reforested, but at the present rate of planting, assuming all plantings are occurring on nonstocked forest land, it would take about 60 years to plant all the nonstocked forest land. Some of the land, however, will be uneconomical to plant. Also, although logging operations usually will create "edge" and other conditions which game animals require, an undetermined acreage of nonstocked forest land should be left for game management.

[1] Forests are classified by type according to the prevalence of certain key species. Consequently, there is some overlapping of species among the general types recognized. For example, stands classified as oak-hickory might be comprised entirely of oak (characteristic of the northern Lower Peninsula) or entirely of hickory. See appendix for definition of terms.

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FIGURE 9.—*Over a million acres of spruce and fir occupy Michigan's forest land. Although many of these stands are young they are potential assets of great value to the State.*

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FIGURE 10.—*Mature jack pine stand. Found primarily in the northern Lower Peninsula, this type covers a million acres in Michigan.*

Michigan Leads the Nation in Reforestation

By 1957, 1,215,300 acres of trees had been planted in Michigan—more than in any other State in the nation. Of this area, 70 percent is publicly owned. Since 1946, however, private planting has increased rapidly, although plantings on public lands still accounted for 30 percent of new plantations in 1957.

The most-planted species in order of area planted are red pine, jack pine, and white pine. Scotch pine has recently been planted extensively by private owners for Christmas trees.

While most planted trees are not yet large enough to cut, many of the plantings are entering the pole-timber-size class. Increasing quantities of pulpwood can be thinned from them during the next decade.

Yields of timber products from plantations have only begun, but other benefits from them are already impressive. Plantations have helped provide cover for wildlife, protect stream banks, stabilize water flow, and prevent erosion. They have important scenic values.

Much remains to be done, however. According to Timber Resource Review estimates,[2] nearly 3 million acres of commercial forest land are available for planting.

The northern Lower Peninsula is the most heavily

[2] U. S. Forest Service. Timber Resources for America's Future. Forest Resource Rpt. 14, 713 pp., illus. 1958.

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FIGURE 11.—*Red pine plantation in northern Lower Michigan. Over 479,500 acres of commercial forest land in this district are now well established forest plantations.*

planted area in the Lake States; by 1956, 603,300 acres of conifers had been planted. More than 479,500 acres are classed as established forest plantings—that is, plantations containing 100 or more live trees per acre (fig. 11). The remaining 131,300 acres are in windbreaks or other small plantings of less than 2½ acres or are failures.

Two-Thirds of Forest Land Privately Owned

Private citizens, other than farmers, own almost 50 percent of the forest land (appendix table 5). Farmers, the second largest ownership class, own 20 percent. The remaining 30 percent is owned by public agencies with the State controlling the largest part.

More than half of the public forest land is in the two Upper Peninsula districts where it occupies about two-fifths of the commercial forest land. Large industrial holdings are prominent in these districts (appendix table 6). In southern Lower Michigan the forest land is almost exclusively held by private owners, mostly farmers. The forests in northern Lower Michigan are about two-thirds privately owned and one-third publicly owned (fig. 12). Here small private owners control most of the privately held land.

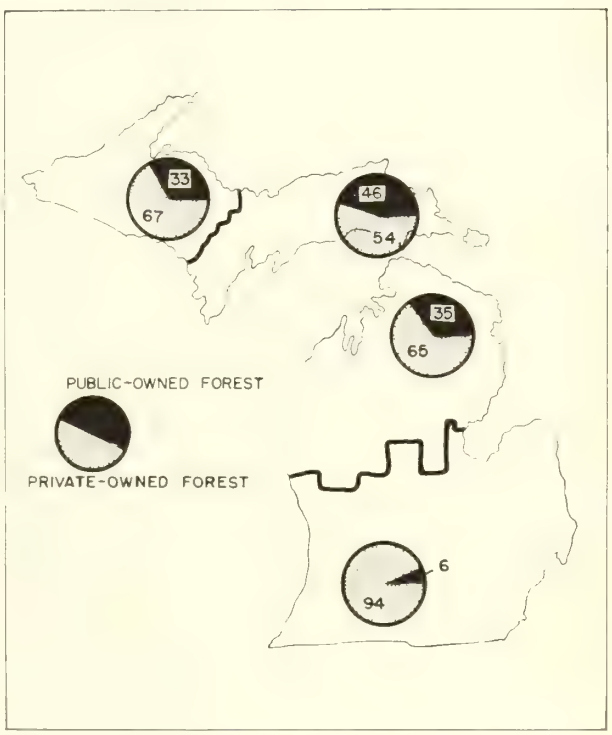

FIGURE 12.—*Percentages of forest land publicly and privately owned in Michigan, by Forest Survey district.*

Stand Size Class Distribution Improving

Forest area in Michigan has increased only 3 percent between the 1935 and 1954 surveys. Along with this small change came an increase in unproductive and reserved forest area so that the net increase in commercial forest area amounted to only 271,000 acres.

Changes in size classes within the forests were more significant (fig. 13). Poletimber stands, which in 1935 occupied only 18 percent of the commercial forest, now occupy 32 percent. Sawtimber and seedling and sapling stands remain in about the same proportion as in 1935. A significant change occurred in stocking within the seedling and sapling stands: In 1935 only about half of these stands were satisfactorily stocked; today three-fourths are satisfactorily stocked. As a result of fire protection, planting, and better management, Michigan's forests are "thickening up."

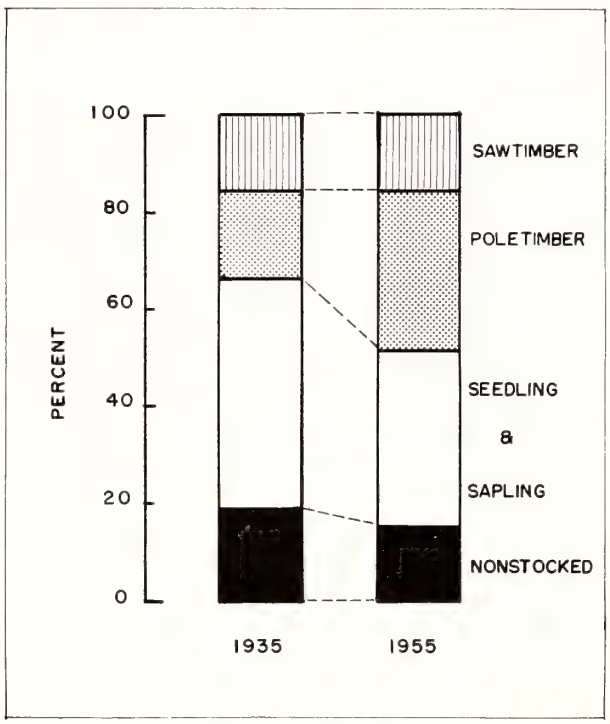

FIGURE 13.—*Comparison of commercial forest area by stand-size class, 1935 and 1955.*

Areas of Pine and "Other Hardwoods" Increase, Spruce-Fir Decreases

Although all forest type acreages changed somewhat, most changes are not significant in terms of the total forest area. However, the area of pine increased, with the bulk of the change coming in the red and jack pine types. Probably this is due to the big increase in planting of these species. On the other hand, the area of spruce-fir and black spruce decreased considerably. Some of this decrease is probably due to the method of classifying forest types, however. For example, when spruce-fir stands are cut, the residual aspen or other hardwoods may constitute the largest volume and are so classified. Actually, spruce-fir reproduction may be present, and in time these stands will again be spruce-fir.

The area of oak-hickory and elm-ash-cottonwood increased by about three-quarters of a million acres. Low-quality trees occupy a significant portion of this area. Much of the half-million-acre increase in the oak-hickory type is accounted for by a corresponding decrease in nonstocked land in the Lower Peninsula, principally in the southern half.

The following tabulation shows the percent of increase or decrease and the change in acreage of the various forest types for the 20-year period between inventories:

Forest type:	Change in percent	Change in area (thousand acres)
Softwoods:		
White pine[1]	+ 9	+ 15
Red pine[1]	+420	+349
Jack pine[1]	+ 30	+229
Spruce-fir	— 46	—636
Black spruce	— 17	— 79
Tamarack	— 47	—117
Cedar	+ 40	+251
Hardwoods:		
Northern hardwoods	+ 2	+ 92
Oak-hickory	+ 37	+485
Elm-ash-cottonwood	+ 43	+291
Aspen-birch	— 4	—198
Nonstocked	— 12	—416

[1] Percents and areas are actually slightly larger since it was not possible to delete reserve forest areas of 6,000 acres from the 1935 figures.

Timber Volumes

Michigan's commercial forests contain 12.8 billion cubic feet of timber (appendix table 7), an average of 8.4 cords per acre. Of the total volume 84 percent is growing stock; the rest is cull and salvable dead trees or limbs of hardwood sawtimber trees. Most of the volume in cull and salvable dead trees will not be used. Almost half of the total volume of live timber is in merchantable poletimber trees (fig. 14). Merchantable sawtimber trees account for 36 percent.

Most Sawtimber in Western Upper and Southern Lower Michigan

The western Upper Peninsula and southern Lower Peninsula districts each have about 30 percent of Michigan's sawtimber. The remaining portion is equally divided between the other two districts. Timber in the southern district runs largely to sawtimber, with 61

percent of the growing stock in this size. Sawtimber is only 28 percent of the growing stock in northern Lower Michigan and 46 percent in the Upper Michigan districts.

Sawtimber Volume Mostly Hardwood

Hardwoods account for almost three-fourths of the total sawtimber volume (appendix table 8), but vary from 60 percent in Upper Michigan to 98 percent in southern Lower Michigan (appendix table 9). The northern hardwood species of sugar maple, yellow birch, beech, and basswood make up about one-third of the total sawtimber volume of all species. Sugar maple, which has the largest volume of any species, accounts for about one-sixth.

Species:	Million bd. ft.
Softwoods:	
White pine	1,199
Red pine	571
Jack pine	384
Spruce	702
Balsam fir	577
Tamarack	65
Cedar	1,010
Hemlock	1,891
Total	6,399
Hardwoods:	
Sugar maple	4,182
Yellow birch	1,194
Basswood	788
Beech	996
Elm	2,598
Red oak	2,012
White oak	972
Aspen	1,174
Cottonwood	135
Paper birch	460
Soft maple	1,474
Ash	503
Other hardwoods	870
Total	17,358
All species	23,757

Hemlock, the leading softwood sawtimber species in volume, has almost one-third of the softwood sawtimber but only 8 percent of the total sawtimber volume.

Some Sawtimber Unavailable

Although the bulk of the sawtimber volume is in trees just large enough to make saw logs, one-fifth of the total volume is in trees 20 inches and larger. Unfortunately, many of these larger trees exist in small isolated stands or as single individuals located in small sawtimber or pole-size stands. Defect in these trees is usually high, and unless they are harvested soon many will become unmerchantable. Similarly, some 35 percent of all sawtimber volume is in stands classed as below sawtimber size. Much of this will be economically available only when it can be harvested along with smaller trees. The distribution of sawtimber by stand-size class is as follows:

Stand-size class:	Million bd. ft.
Sawtimber	[illegible]
Poletimber	[illegible]
Seedling and sapling	[illegible]
Nonstocked	[illegible]
Total	23,757

Sawtimber Quality Generally Low Because of Small Size

The average sawtimber tree is small. Since only larger trees can contain No. 1 and No. 2 saw logs, Michigan's average sawtimber quality is low. Indeed, volume in trees of the 10-, 12-, and 14-inch diameter classes constitutes over 54 percent of the total sawtimber volume (appendix table 10). Such trees are too small to contain grade-1 logs. Many of these smaller trees growing on better sites are of good form and will produce good-quality lumber and veneer material in the future if left to grow. Quality of merchantable sawtimber in Michigan is as follows:

	Percent of volume in log grades—[1]		
Species:	No. 1	No. 2	No. 3 and tie and timber
Softwoods:			
White pine	10	22	68
Red pine	10	22	68
Hardwoods:			
Sugar maple	15	36	49
Yellow birch	21	34	45
Basswood	5	26	69
Beech	10	40	50
Elm	4	34	62
Red oak	10	18	72
White oak	23	28	49
Aspen[2]	1	0	99
Soft maple	16	37	47
Ash	20	28	52
Other hardwoods	23	8	69

[1] For specifications and references see appendix.

[2] Aspen, a short-lived tree, seldom reaches large sawtimber size.

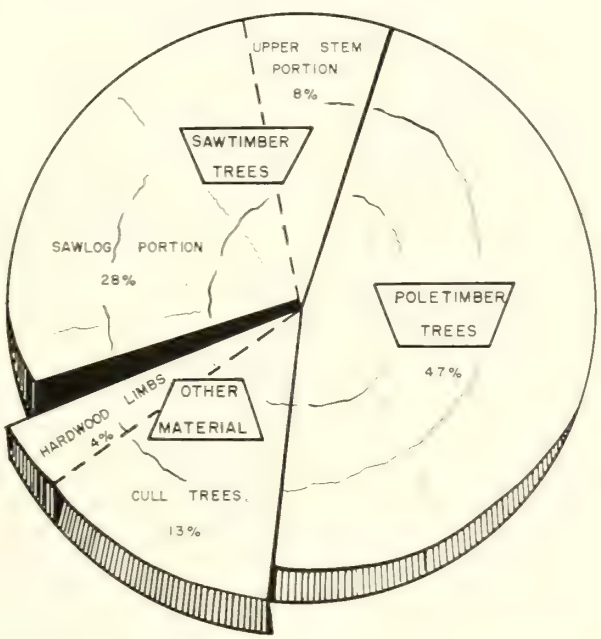

FIGURE 14.—*The percentage of volume of live timber on commercial forest land in various kinds of material.*

From this log-grade distribution a fairly accurate quality estimate of lumber contained in trees can be obtained. For instance, properly sawed grade-1 yellow birch logs will yield on the average 70 percent of lumber in No. 1 common and better, 11 percent in No. 2, and 19 percent in No. 3 or poorer.

Most of the sawtimber volume is in log grade 3 and in tie and timber logs. On the other hand, over half of the volume of the high-value northern hardwood logs—sugar maple, yellow birch, and beech—is in log grades 1 and 2.

Smaller Timber Also Important

Although most of the products harvested in 1954 came from sawtimber trees, 38 percent of the total harvest came from smaller trees. Thus, these small trees are of vital importance to Michigan's timber industry (figs. 15 and 16).

The total volume of cordwood material (poletimber and tops of sawtimber trees) is 88 million cords, or more than 7 billion cubic feet (appendix table 11). Of this material, 14 percent is in tops of sawtimber trees and the remaining 86 percent is in poletimber trees.

Aspen has the largest volume of the principal pulpwood species, more than one-half of the total.

	Total (thousand cords)	In sawtimber[1] trees (thousand cords)	In poletimber trees (thousand cords)
Principal pulpwood species:			
Jack Pine	3,880	1,017	2,863
Spruce	4,210	1,897	2,313
Balsam fir	5,190	1,552	3,638
Hemlock	5,480	4,718	762
Total	18,760	9,184	9,576
Aspen	22,240	2,890	19,350
All pulp species	41,000	12,074	28,926

[1] Includes tops.

It is significant that over four-fifths of the supply of hemlock is composed of sawtimber-size trees while other pulp species are primarily pole size. A third of the hemlock sawtimber is over 20 inches in diameter, and half is greater than 15 inches.

F-494009

FIGURE 15.—*Improvement cut in young pine stand in northern Lower Michigan. This material is important to the pulp and paper industries in the State.*

F-494010

FIGURE 16.— *Cedar fence post being "peeled" in Upper Michigan. Cedar posts valued in excess of $2,000,000 were produced in 1954.*

Pulpwood Volume Well Distributed in Northern Districts

Aspen, containing the largest pulpwood volume, is found in the greatest amounts in northern Lower Michigan (fig. 17). This district also supports 60 percent of the jack pine volume. Spruce, fir, and hemlock are presently almost entirely Upper Peninsula species (appendix table 12).

Most Timber Privately Owned

Private owners hold about three-fourths of Michigan's timber volume (appendix table 13). Small private owners (those owning less than 5,000 acres) own more timber than any other group, holding 44 percent of the private timber volume and 32 percent of the total timber volume in the State.

Public ownership of timber is divided between State and national forests, with other public agencies holding less than 2 percent of the public timber volume and less than 1 percent of the total timber volume in the State.

Volume Increases on Lower Michigan Forests

Between 1935 and 1955 Lower Peninsula growing stock almost doubled and sawtimber increased 1½ times, while Upper Peninsula sawtimber volumes decreased (appendix table 14).

	Percent volume change, 1935-55	
	Upper Peninsula	Lower Peninsula
Growing stock:		
Pine	+ 60	+ 81
Hemlock	− 73	− 17
Other softwoods	− 24	+ 89
Northern hardwoods	− 49	+ 61
Aspen-cottonwood	+ 102	+ 135
Other hardwoods	+ 28	+ 104
Total	− 29	+ 96
Sawtimber volume:		
Pine	− 45	+ 136
Hemlock	− 71	− 13
Other softwoods	0	+ 104
Northern hardwoods	− 53	+ 55
Aspen-cottonwood	+ 149	+ 144
Other hardwoods	+ 12	+ 213
Total	− 41	+ 146

Pine, aspen, and other hardwoods increased in sawtimber and growing stock volume, both in Upper and Lower Michigan. Within the pine group red pine accounted for most of the increase, 133 percent, and white pine the least, 24 percent.

The northern hardwood volume growing stock declined enough in Upper Michigan to offset the increase in Lower Michigan and cause a net loss of 1,294 million cubic feet in the State total. Sawtimber volume alone decreased 5,020 million board feet.

F-494011

FIGURE 17.—*Stand of aspen in northern Lower Michigan. Aspen, once considered a weed, is now an important pulp species.*

Net Annual Growth

Annual Growth Rate 4½ Percent

During the inventory period, estimated net annual growth of all timber 5.0 inches and larger on commercial forest land was 492.6 million cubic feet (appendix table 15). This includes 1,139 million board feet of sawtimber and 3.3 million cords of poletimber, indicating an increase, before cutting, of approximately 4.6 percent of the growing stock annually. Hardwoods make up 73 percent of the total growth. Aspen alone accounts for slightly over one-fifth of the total. Northern Lower Michigan has the highest total volume of growth (appendix table 16).

Net annual growth of softwoods is equivalent to 5.2 percent of the present growing stock; for hardwoods it is 4.4 percent. Jack pine annual increment before cutting is 10.5 percent, the highest rate of increase of any species in Michigan. Balsam fir (7.1 percent), tamarack (8.7 percent), and aspen (6.1 percent) also have high volume increases because of growth. The northern hardwood species and hemlock have the lowest rates of increase.

A substantial portion of the annual growth is "ingrowth." This is the total volume of small trees that reach minimum poletimber size (5.0 inches) during the year. Sawtimber ingrowth is the volume of poletimber trees that reach minimum sawtimber size (9.0 inches for softwoods and 11.0 inches for hardwoods).

Sawtimber Growth More Than Doubled Since 1935

In 1935, sawtimber growth was low because much of the sawtimber was in old-growth stands where growth was largely offset by death and decay. In the following 20-year period the harvesting of these stands and ingrowth resulted in a 10-percent loss in sawtimber volume but a 132-percent jump in sawtimber growth. The increases in sawtimber growth are large for most species groups, although northern hardwoods remain about the same. "Other" hardwoods have the largest physical gain, while aspen-cottonwood have a slightly higher percentage increase.

Growing stock volumes increased 56 percent during the 20-year period. In terms of growing stock, northern hardwoods and aspen-cottonwood have increased the least; the latter species group actually declined. The slowing down of growth as the short-lived aspen-cottonwood group grows older, coupled with a tapering off of ingrowth, probably accounts for much of this group's failure to increase in growth. Pine shows heartening increases, but "other" hardwoods outstrip all species groups.

A comparison of 1935 and 1955 annual net growth estimates on commercial forest land by species groups follows:

	1935 (million cu. ft.)	1955 (million cu. ft.)
Growing stock:		
Pine	20	51
Other softwoods	44	83
Northern hardwoods	54	75
Aspen-cottonwood	112	109
Other hardwoods	87	175
Total	317	493
	(Million bd. ft.)	(Million bd. ft.)
Sawtimber:		
Pine	62	168
Other softwoods	93	200
Northern hardwoods	156	163
Aspen-cottonwood	36	149
Other hardwoods	145	459
Total	492	1,139

The biggest single factor causing the increase in growth, particularly in the seedling and sapling and pole-size stands, is the improved fire protection that has taken place since the mid-thirties. Stands have been allowed to thicken up, and second-growth trees are now reaching the size where they are putting on their greatest net increment.

The growth, although showing a substantial increase over the past 20 years, still falls far short of the potential productive capacity of the land. Current growth would be greater if losses caused by suppression, insects, and disease could be reduced. Some of the losses could be avoided by salvage cuttings in decadent stands and thinnings in dense pole stands. The loss of potential growth due to understocking and to unbalanced distribution of size classes is at least as large as that due to mortality.

Further Growth Increases Possible

The following tabulation shows the timber volumes and net annual growth rates that will be attainable if forest management and the economy continue to expand as indicated by recent trends.

	Growing stock		Sawtimber	
	Net volume (million cu. ft.)	Net growth (million cu. ft.)	Net volume (million bd. ft.)	Net growth (million bd. ft.
Year:				
1955	10,713	493	23,757	1,139
1965	13,508	537	28,216	1,281
1975	16,494	582	33,023	1,423
1985	18,908	627	37,711	1,566
Net change	8,195	134	13,954	427

Naturally, such projections are speculative, not only because of uncertainty as to management practices of landowners and as to future utilization but also because of still incomplete knowledge of forest type behavior under all kinds of treatment. Much of Michigan's forest area is covered by temporary and changing forest types, of which the future composition cannot yet be accurately foretold.

It should be emphasized that the projections assume a continuation of present trends. For example, the increased pulpwood drain from growing stock in the recent past is a reflection of the expansions of capacity and new plant additions in the pulp industry. Projections of this drain allow a margin for additional expansion of industry. The size of this margin is dependent on past increases modified by anticipated demand factors.

Mortality Losses High

A fire burning all the timber harvested in the Upper Peninsula in 1954 would destroy no more wood than that killed *annually* in Michigan by destructive agents —insects, disease, fire, wind, and other natural causes (fig. 18). The annual loss amounts to 112 million cubic feet, including 278 million board feet of sawtimber (appendix table 17). It equals 1 percent of the total growing stock, it is one-quarter as large as the total annual net growth (fig. 19), and it is equivalent to the total net annual growth of the seven counties in eastern Upper Michigan.

Fire, which was once the leading cause of mortality and is still a great threat, has been reduced to less than 1 percent of the total loss (fig. 20). The 5-year period of 1950-54 had an average annual burn of 8,400 acres as compared to the 1935-39 period of 41,200 acres.[3]

FIGURE 18.—*Eutypella canker on sugar maple. In the last three decades disease has replaced fire as the most important cause of mortality in Michigan.*

[3] U. S. Forest Service, Division of Cooperative Fire Protection. Forest Fire Statistics, issued annually.

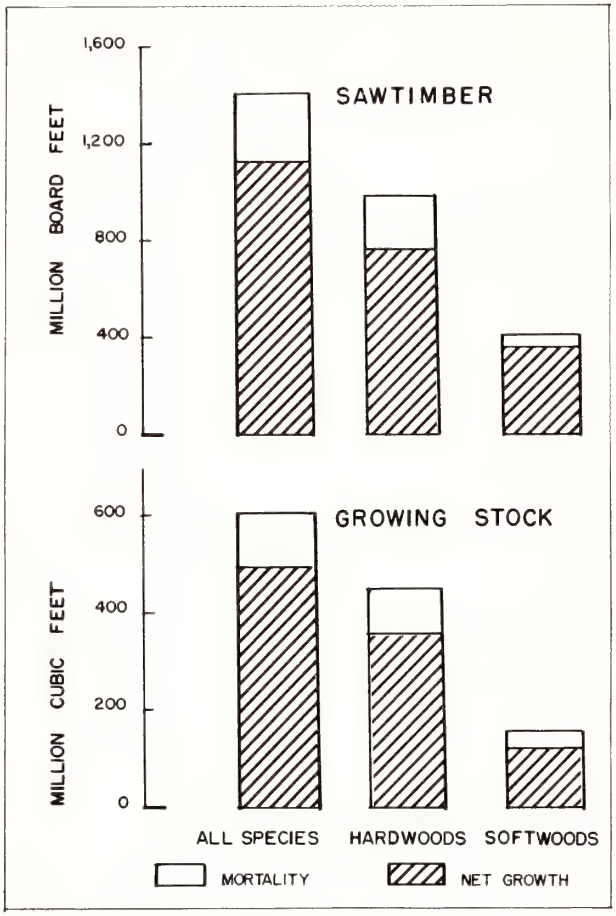

FIGURE 19.—*Annual mortality and net growth of sawtimber and growing stock. Mortality is about one-quarter as large as net growth.*

Notable among the insect pests are the jack-pine budworm, European pine shoot moth, larch sawfly, white-pine weevil, forest tent caterpillar, Saratoga spittlebug, and various pine sawflies.

Some of the major diseases are Hypoxylon canker of aspen, white pine blister rust, oak wilt, and Dutch elm disease. Hypoxylon canker is a serious threat because it necessitates early cutting of aspen to avoid heavy losses. White pine blister rust is one of the chief causes of white pine mortality. Both oak wilt and Dutch elm disease are relatively new in Michigan. Their most serious feature is the difficulty of control once they attack a stand of oak or elm.

Rots Account for Two-Thirds of Cull

Several heart rots are of importance also because they make it difficult to produce sawtimber-size trees of pine and aspen. Butt and stem rots are the greatest destructive agents affecting timber volume. They infect all species but cause the greatest damage in the hardwoods. Survey results show that of the 1.6 billion cubic feet of cull trees, about two-thirds is in rotten trees—that is, trees with over 60 percent of their gross volume unusable because of rot. However, this figure is for net volume only—a measurement of sound wood suitable for fence posts, chemical wood, and fuelwood contained in these trees. The gross volume of these trees, if they were without defect, would be almost doubled. As only a very small portion of this wood will ever be used, most of the volume in such trees can be considered as lost. But even more serious than the loss of actual volume is the loss of future growth.

Mortality and growth loss can be materially reduced with more intensive utilization and new markets, accompanied by conscious efforts to improve forest lands. In recent years the use of poor-quality material in the charcoal and chemical extraction field has helped, but an immense amount of defective or poorly formed timber still remains scattered throughout the hardwood stands.

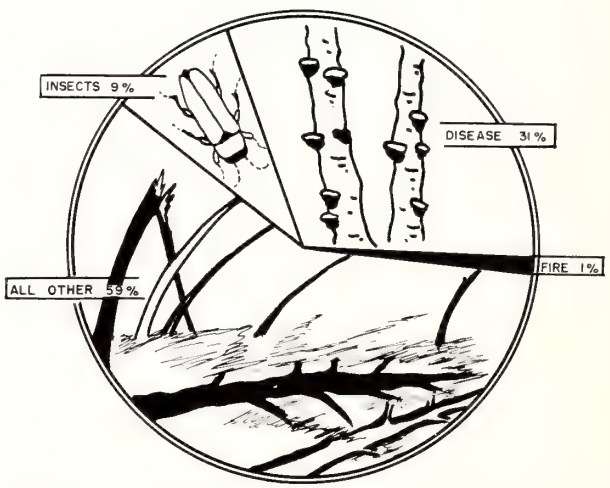

FIGURE 20.—*Mortality causes for all growing stock, 1954. The "all other" includes losses from windstorm, suppression, animals, and a variety of minor causes.*

Forest Industries and Timber Cutting

Industries That Use the Timber

Approximately 2,100 primary wood-using plants operated in Michigan during 1954 (appendix table 18). Most of these were small sawmills and other small enterprises. Only about 5 percent could be called large industrial plants. These were the larger sawmills; pulp mills; veneer, chemical, and excelsior plants; and several others.

Much of the lumber, wood pulp, veneer, and other products of these mills goes to local secondary wood-using plants for further manufacture. Some of the end products are furniture, wooden boxes, millwork, paper, and paperboard products. Together, Michigan's primary and secondary wood-using industries employ about 100,000 persons full or part time, pay direct salaries and wages of over a quarter of a billion dollars, and turn out products worth nearly three-quarters of a billion dollars.

Sawmills Increasing But Output Drops

Michigan sawmills are increasing in numbers, but their annual output is declining. Although approximately 2,000 sawmills were recorded in Michigan in 1954 compared with 1,400 in 1945, the lumber output during that period dropped from 421 million board feet to 362 million.

Lumber production in Michigan reached an alltime high in 1889 when some 1,000 sawmills cut approximately 5½ billion board feet. Michigan was the No. 1 lumber-producing State for 10 years until 1899 but then, with rapid reduction of pine timber, production started to drop off abruptly (fig. 21). The low point was reached in 1932 when only 160 million board feet were cut. After the depression years production started to climb, continuing upward through World War II and the postwar years. A peak of 615 million board feet was reached in 1948. Since then the general trend has been downward.

Typical of the 11 larger mills is the Kimberly-Clark bandmill at Marenisco. The mill and woods operations provide work for about 200 employees. This mill processes about 12 million board feet of logs to lumber each year. The better grades of hardwood lumber are shipped to the furniture trade, the intermediate grades are used mostly for flooring and core stock, and the lower grades are shipped to the iron ore mines. Wood chips are produced as a byproduct from sawmill waste; these are shipped to chemical and charcoal plants.

The number of medium-sized mills has increased. Michigan had only 70 such mills in 1945 compared with 85 in 1954. Some of these have replaced larger mills; others have started operations in new locations. Many of the new installations are geared to utilize more aspen, jack pine, and other second-growth timber. Installation of this type of mill is a hopeful sign, since these mills usually do a better job of utilization than the smaller ones, which operate intermittently.

One of several medium-sized sawmills that have recently been rebuilt and modernized is the Michigan Pole and Tie Company mill at Newberry. The rebuilt mill cuts about 5 million board feet of lumber and related products annually. About 4 million of this is hard maple, birch, beech, and soft maple, and 1 million is softwood lumber made up of white pine, hemlock, spruce, and red pine (fig. 22).

Small mills, each with an annual output of less than one million board feet, make up about 95 percent of

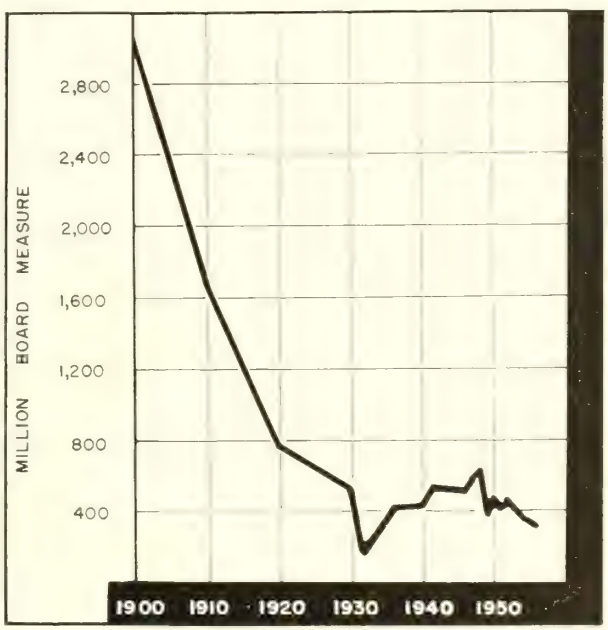

FIGURE 21.—*Michigan lumber production, 1900-56.*

FIGURE 22.—*The Michigan Pole and Tie Company mill at Newberry represents one of many medium-sized mills capable of producing quality lumber. Hardwood and white pine lumber is carefully cross-piled by hand. White pine is chemically treated to prevent discoloration during seasoning. (Photo courtesy Michigan Pole and Tie Company.)*

Michigan's sawmill population, but accounted for only one-third of the State's total lumber output in 1954 (fig. 23).

Characteristically, small mills are powered by gasoline or diesel engines. The majority are equipped to move from one logging area to another as stumpage supplies and custom-sawing jobs are obtained. They operate only a part of the year, producing mostly rough lumber, box and crating boards, and railroad crossties.

Of the estimated 361 million board feet of lumber produced in 1954, three-fourths was hardwood, one-quarter softwood. Nearly two-thirds was sawed in the Upper Peninsula (fig. 24). About 10 percent was from trees of poletimber size (smaller than normal saw log size).

Logs are frequently hauled to mills across the Michigan-Wisconsin State line. Michigan sawmills imported about 2 million board feet of lumber logs from Canada and Wisconsin, and in turn Michigan exported about 23½ million board feet of logs to Wisconsin sawmills in 1954. All told, 383 million board feet of lumber logs and bolts were harvested in Michigan.

Michigan Pulp Mills Increase in Number and Output

Thirty-eight concerns operated 52 paper mills and 11 pulp mills in Michigan during 1954. These mills produced about 1½ million tons of paper and paperboard, employed an estimated 25,000 employees exclusive of woods workers, and turned out products worth about 250 million dollars. Three-fourths of the paper mills are located in the southern part of the State. In 1954 their output consisted largely of printing, writing, drawing, and industrial papers, and paperboard.

Of the 11 Michigan pulp mills all except one were operated in conjunction with paper or paperboard mills. The plants at Escanaba, Manistique, Menominee, and Cheboygan were groundwood mills and the pulp was processed mainly into groundwood papers, paperboard,

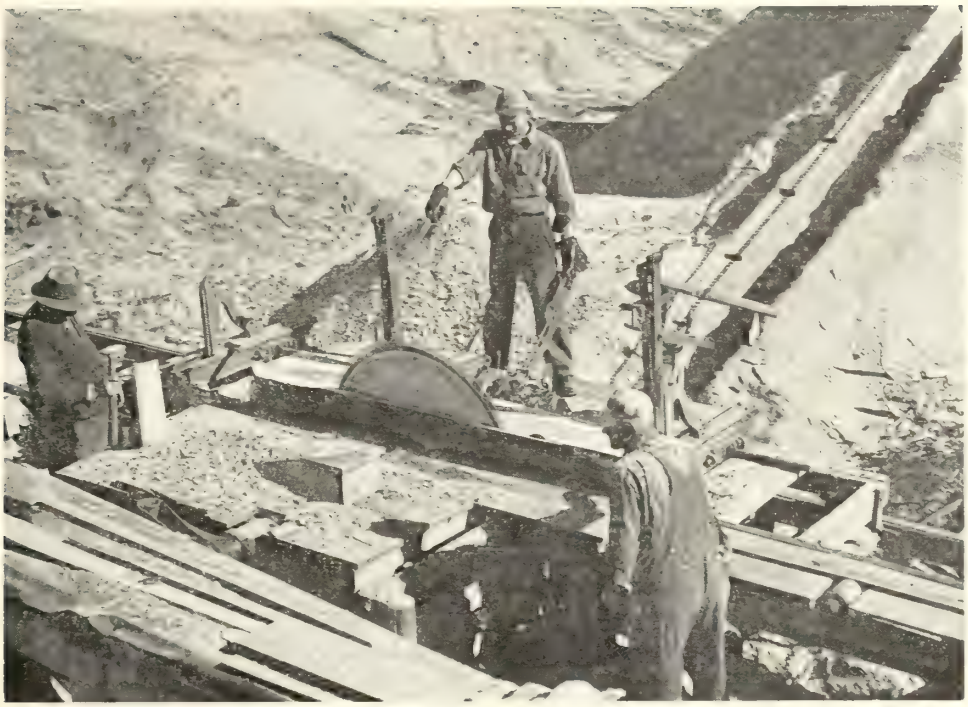

FIGURE 23.— *Small sawmills account for about one-third of Michigan's lumber production. Because of misaligned or wornout equipment many small mills manufacture a poor grade of lumber. Much of it is miscut and unfit for commercial use. A recent lumber survey shows that about 35 percent of the small mill operators sawed for their own use, 40 percent operated on a custom basis, and only about 25 percent sawed for commercial markets.*

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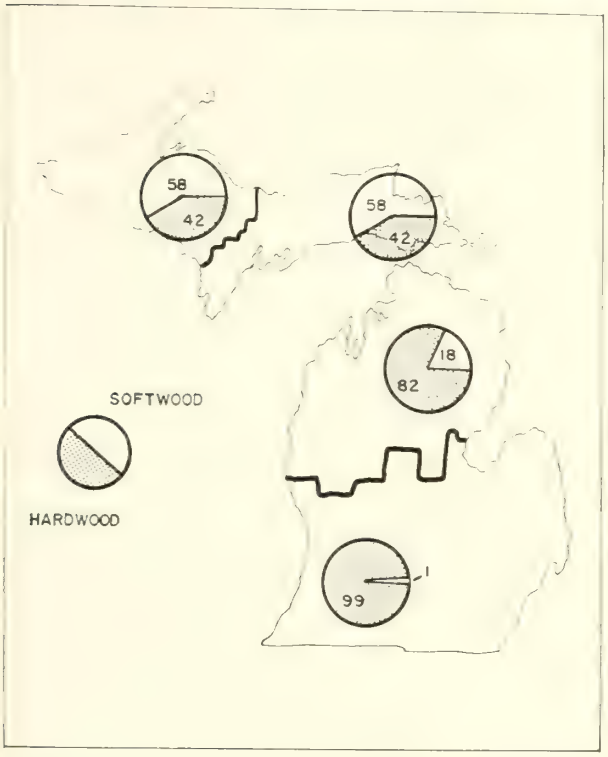


FIGURE 24.—*Of the total lumber cut in 1954, 47 percent was in western Upper Michigan, 16 percent in eastern Upper Michigan, 19 percent in northern Lower Michigan, and 18 percent in southern Lower Michigan. The maples, hemlock, and birch were the principal lumber species cut in the Upper Peninsula; the oaks, maples, elm, and aspen were most heavily cut for lumber in the Lower Peninsula.*

and specialties. Mills at Munising, Detroit, and Muskegon used chemical processes (sulphate or sulphite) to turn out a wide variety of paper and paperboard. Mills at Ontonagon, Filer City, Otsego, and Watervliet pulp hardwoods by a semichemical process for use in manufacture of corrugating board, paperboard, and industrial and book papers.

Michigan's woodpulp industry continues to grow. More than 40 million dollars were spent from 1956 to 1958 for construction of new mills and expansion of existing facilities.

New mills are operating at Filer City, Alpena, and L'Anse. The new bleached kraft paperboard mill at Filer City represented the largest single outlay, and provided equipment for converting 100,000 cords of pine and 20,000 cords of aspen pulpwood annually to highly bleached food board (fig. 25). An additional 180,000 cords goes to the older mill at the same location which produces corrugated medium paperboard for shipping containers.

Pulpwood Cut Climbing; Now Close to Million Cords

From a modest 200,000 cords at the beginning of the century, pulpwood production has climbed to nearly 1 million cords in recent years (fig. 26). Most of the increase is attributable to the heavier cutting of aspen. In

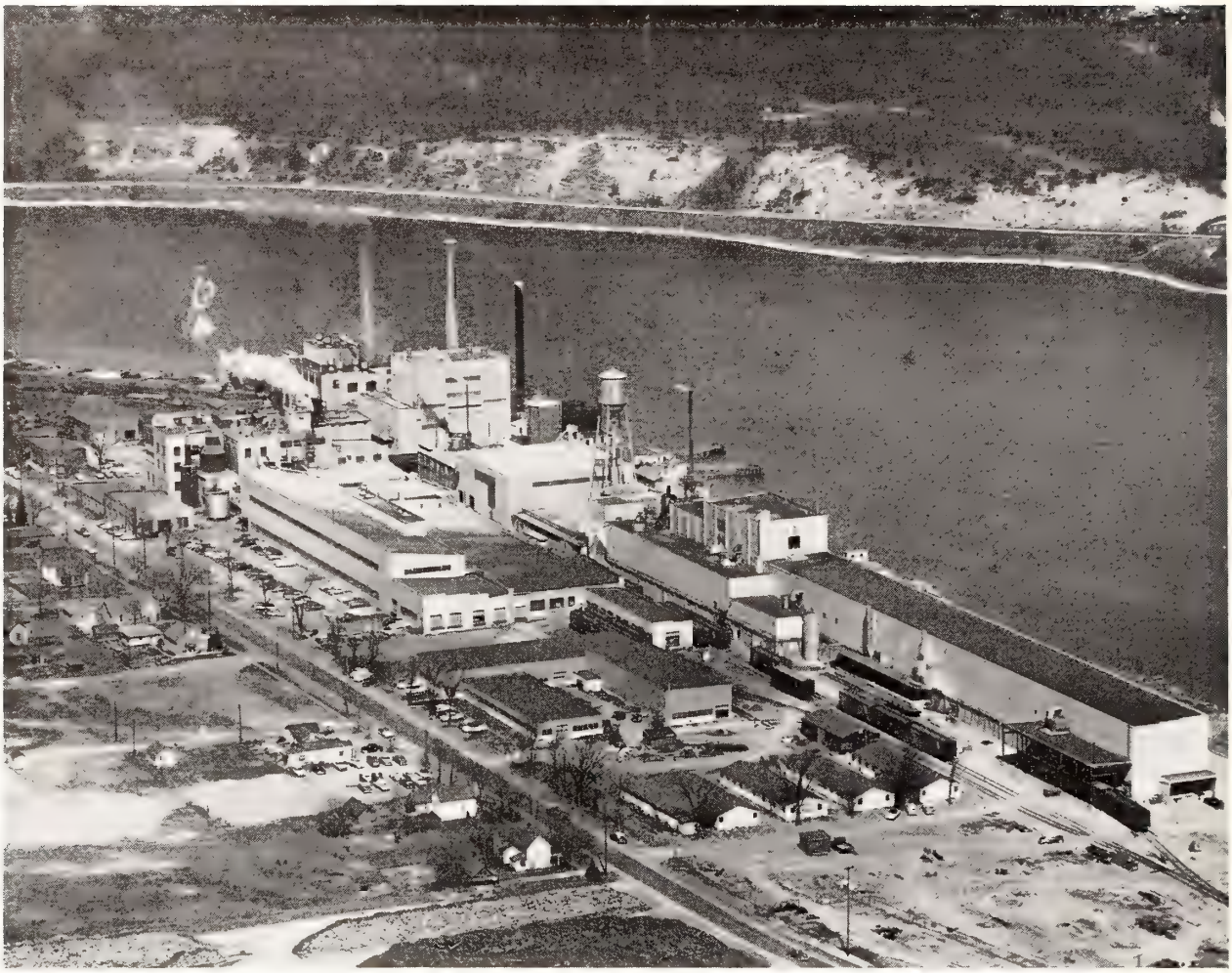


FIGURE 25.—*The Packaging Corporation of America at Filer City is the largest wood-using plant in Michigan. The recent multimillion dollar expansion has increased its total wood requirements to over 300,000 cords per year. (Photo courtesy of Packaging Corporation of America.)*

1936 only 30,000 cords of aspen were cut compared to the present annual cut of over a half-million cords. Hemlock, at one time a much sought after species, has been relegated to minor importance.

Pulpwood cut in Michigan during 1954 was 797,100 cords. Of this amount, resident mills received 310,000 cords; 475,000 cords went to Wisconsin, and 12,000 cords to mills outside the region. More than two-thirds of the pulpwood, including 90 percent of the softwoods and slightly more than 50 percent of the hardwoods (mostly aspen), was harvested in the Upper Peninsula (fig. 27). This pattern has changed recently—now more hardwood pulpwood is cut in the Lower Peninsula than in the counties north of the Straits.

Michigan mills imported about 100,000 cords of spruce, balsam fir, and aspen, mostly from Canada.

The 1954 pulpwood harvest removed 62.2 million cubic feet of growing stock, which is one-third of the total removed for all products. About 71 percent of the timber cut for pulpwood was from poletimber trees; the remaining 29 percent was made up of saw log material and tops of sawtimber trees.

Veneer Mills Decreasing in Number

Four large veneer plants were operating in Michigan during 1954. Since then the Atlas Plywood Company mills at Gladstone, Munising, and Newberry have closed. The one remaining large veneer plant is at Escan-

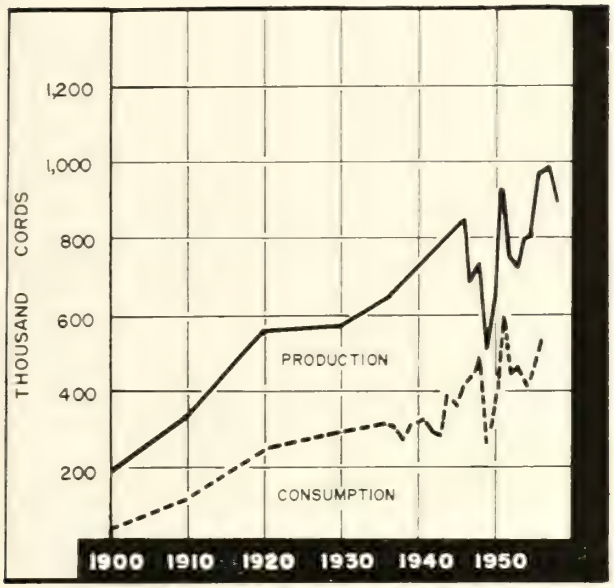


FIGURE 26.—*Trend in (1) pulpwood production in Michigan, and (2) pulpwood consumption by Michigan mills, 1900-1956. The consumption data include imports.*

aba (fig. 28). It produces the more specialized veneers including birch, maple, oak, pine, basswood, cherry, and walnut. These go mainly to plywood mills.

The container-type veneer mills are much more common than the standard-grade veneer mills in Michigan; yet they too are decreasing in number. One of the few remaining large-sized container mills is the Frank Deaner and Son mill at Sodus, Mich. This plant got its start 50 years ago when baskets started to replace barrels for shipping apples, pears, and other fruit. Each year approximately 1 million fruit packages of different shapes and sizes are manufactured at this plant and distributed to fruit exchanges, growers, and dealers in southwestern Michigan. To produce the different kinds of fruit containers much local timber is used. Logs of soft maple, elm, beech, and sycamore are purchased within a 30-mile radius of the mill. In addition to baskets the plant assembles berry crates, using veneer shipped in from Tennessee mills.

About 34½ million board feet of veneer logs were cut in Michigan during 1954. More than three-fourths of the logs were cut in the Upper Peninsula (fig 29). Current production is only about one-quarter of what it was 10 years ago.

Michigan plants consumed about one-half of the total veneer log output; the remaining half was shipped mostly to Wisconsin mills. A small quantity went to mills outside the region, primarily to Indiana. Mills operating in Michigan imported nearly 3½ million board feet of veneer logs from Canada, other Lake States, and Central States.

Wood Distillation Industry Largely a Charcoal Operation

Demand for the products of Michigan's wood distillation industry has changed frequently. First it was charcoal for production of pig iron, then came demand for chemical byproducts. Now the major use of charcoal is for outdoor cooking, while the industrial market for byproducts is declining.

Today only two large charcoal plants are in operation —the Kingsford Chemical Company at Iron Mountain and the Cliffs-Dow Chemical Company at Marquette. These are perhaps the largest woods residue operations in the nation. The plant at Marquette has sufficient retort capacity to carbonize 100,000 cords of wood per year. All of the material used is low-grade or defective and generally not suitable for other commercial purposes (fig. 30).

Since the mid-fifties several small charcoal plants have sprung up in the State. A total of 3,000 cords of

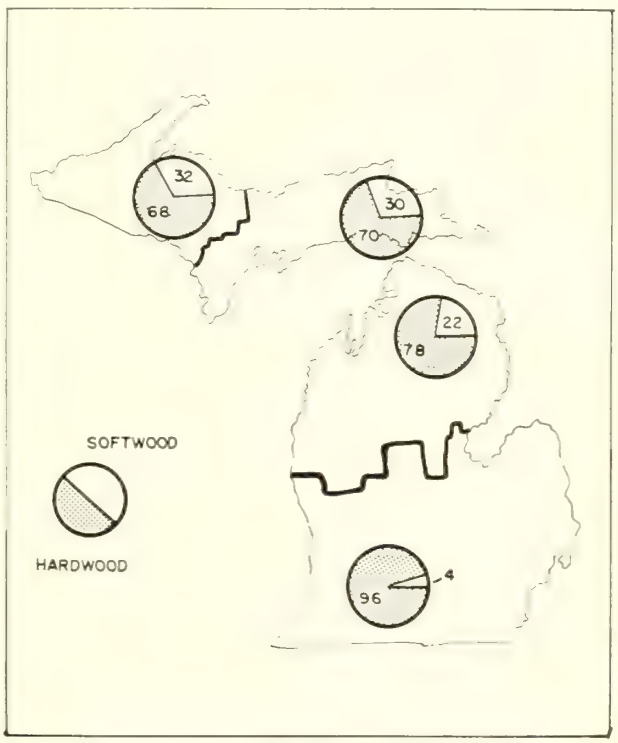


FIGURE 27.—*Of the total pulpwood cut in 1954, 45 percent was harvested in western Upper Michigan, 24 percent in eastern Upper Michigan, 28 percent in northern Lower Michigan, and 3 percent in southern Lower Michigan.*

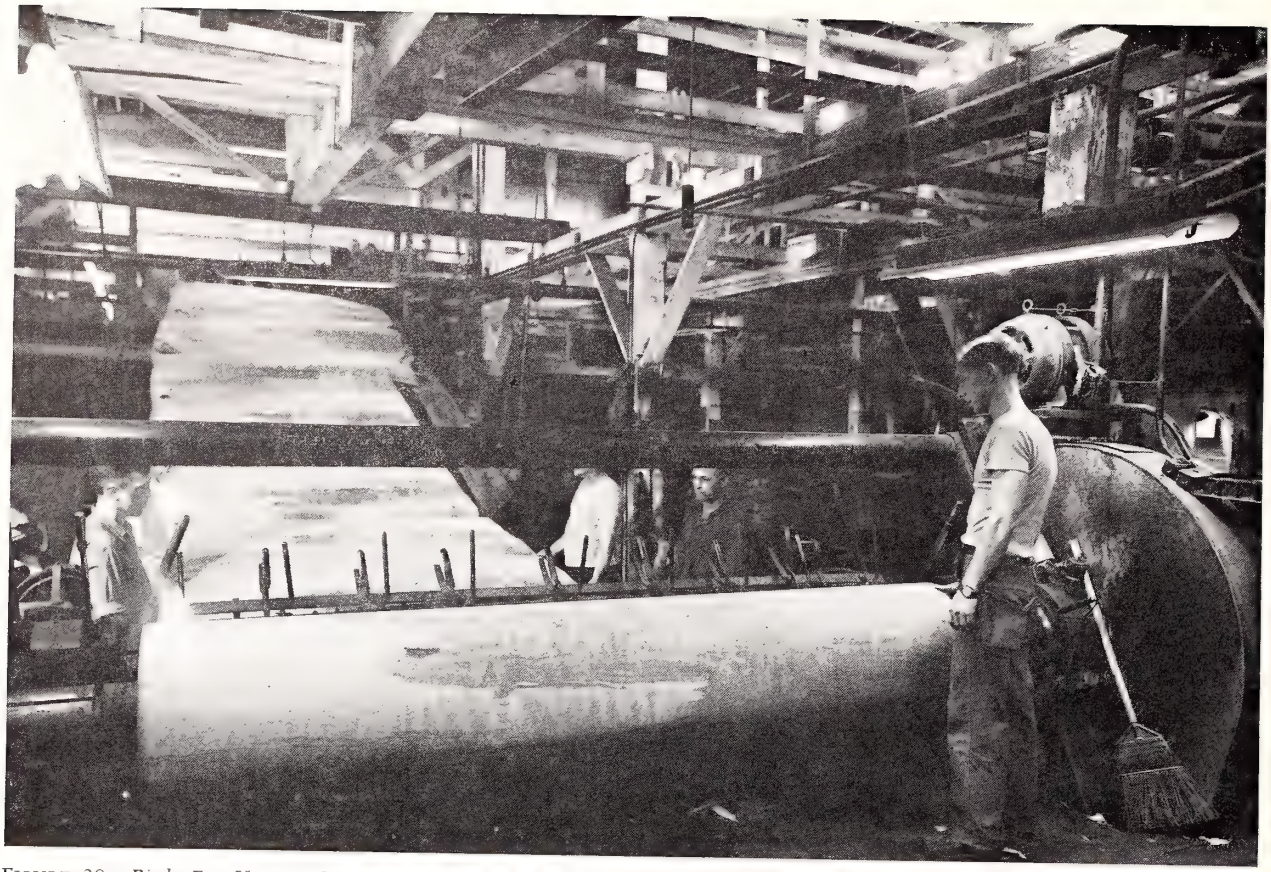


FIGURE 28.—*Birds Eye Veneer Company operation at Escanaba showing the flow of yellow birch veneer. The majority of logs used are purchased on the open market throughout northern Michigan. The annual cut of logs (all species) is approximately 6 to 8 million board feet per year. The company presently employs about 150 people. (Photo courtesy of Birds Eye Veneer Company.)*

logs, bolts, and slabwood was used by these small plants to produce about 1,000 tons of charcoal in 1956.

The cut of chemical wood in 1954 was about 126,000 cords. This removed only about 25,000 cords from growing stock. Cull trees, and woods and mill residues made up the remaining 101,000 cords.

Other Plants of Varying Sizes and Descriptions

Plants listed as "miscellaneous," about 100 in number, are mostly small enterprises and are widely scattered throughout the State. They used about 50,000 cords of logs and bolts (mostly aspen and other hardwoods) in 1954. Probably the largest wood-consuming plant in this group is the excelsior mill at Grand Rapids.

Other primary wood-using plants in this category generally use short logs and bolts. Their products are a heterogeneous group of items such as fish boxes, crating stock, clothespins, ice cream and popsickle sticks, rustic cabin logs, rustic furniture, shingles, lath, dimension stock, woodenware, and dowels.

Some Products Used in Round Form

Cutters produced about 21,000 utility poles in 1954, nearly all from northern white-cedar in Upper Michigan. Most poles are seasoned and treated in concentration yards before they are used.

Most of the 337,000 lineal feet of piling (11,000 pieces) produced in 1954 was hardwoods (primarily oak) with a very little red pine and spruce. All of the hardwood piling was cut in Lower Michigan, all of the softwood piling in Upper Michigan. The Michigan Highway Department was a large user.

More than 1 million cords of fuelwood were produced in Michigan during 1954, compared to 3 million cords in 1936. Of this amount 850,000 cords were cut in the woods, while the remaining 200,000 cords came

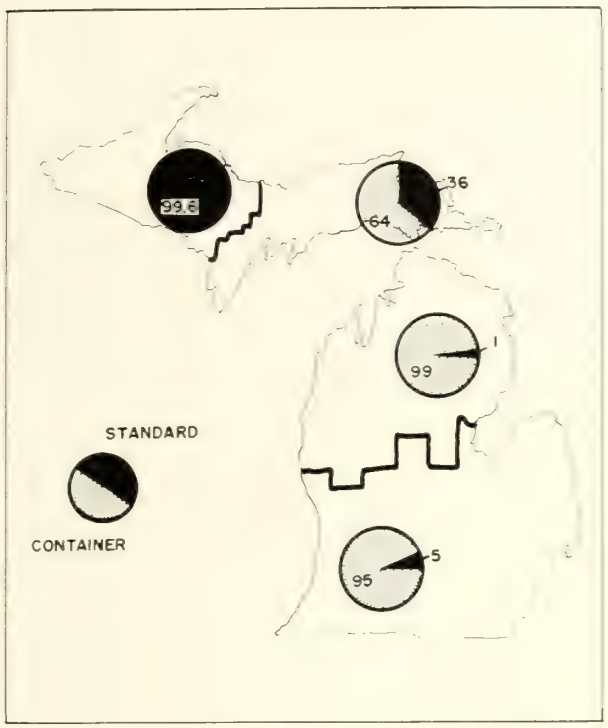


FIGURE 29.—*Of the veneer logs cut in 1954, 34 percent were cut in western Upper Michigan, 44 percent in eastern Upper Michigan, 2 percent in northern Lower Michigan, and 20 percent in southern Lower Michigan.*

from mill residues in the form of slabs, edgings, veneer cores, shavings, and sawdust. More wood was cut for fuel than for any other single product. Only one-fourth of the fuelwood, however, was cut from growing stock; the rest came from cull trees, limbwood, mill residue, and other sources. About 70 percent of the fuelwood was cut in Lower Michigan, mostly by farmers. Nonfarm residents cut over one-half of the fuelwood produced in Upper Michigan.

Nearly 7 million posts were cut by farmers and commercial loggers in 1954. About three-fourths of the posts were cut from live standing timber of merchantable size; the rest came from cull material, dead trees, and limbwood. Cedar posts made up about 85 percent of the total, oak 10 percent, and miscellaneous species 5 percent.

A large part of the cedar post production is put into rustic fencing and gate and sidewalk arbors. Establishments manufacturing these items are located at Escanaba, Gladstone, Stephenson, Wallace, and elsewhere.

Only the iron and copper mines use any appreciable quantity of round and split wood for mining in Michigan. To meet the needs of 41 local iron mines and 11 copper mines, more than 3¾ million cubic feet of wooden mine products were cut in 1954.

Because of new bracing methods, including substitution of steel for wood, and increased use of wood preservatives, the need for wood material at local mines has been decreasing. Today only ¼ cubic foot of wood is required per gross ton of ore produced compared to 2/3 cubic foot in 1936.

Rough Forest Products Valued at Millions

The value of the stumpage cut amounted to about 15 million dollars in 1954. From this timber rough forest products were produced having a total value of approximately 50 million dollars. Lumber logs and bolts for sawmills yielded 17 million dollars; next were pulpwood at about 13 million dollars, and fuelwood at 12 million:

	Value on stump	Value f.o.b. cars
Forest product:		
Lumber logs and bolts	$ 7,600,000	$17,000,000
Veneer logs and bolts (both standard and container grade)	1,200,000	3,000,000
Pulpwood	3,500,000	12,700,000
Fuelwood:		
From trees	1,700,000	11,000,000
From mill residue	—	1,000,000
Chemical wood	150,000	1,400,000
Posts	340,000	2,000,000
Other	510,000	1,900,000
Total	$15,000,000	$50,000,000

The processed value of these same products—i.e., saw logs to lumber, pulpwood to paper—amounted to five or six times the 50 million dollars for logs, bolts, and other rough products.

The 1954 Timber Harvest

Timber cutting in Michigan, at a high point in 1900, went into a decline which reached the bottom in 1932. Logging activities were stepped up in the late 1930's and continued upward until 1948. Since then the trend in cutting generally has been downward, although the trend of pulpwood is upward (fig. 31).

The total cut of live merchantable timber in 1954 was 177.4 million cubic feet, the equivalent of about 2.2 million cords (appendix table 19). This included 544.7 million board feet of saw logs and 1 million cords of cordwood material. An additional 69 million cubic feet (864,000 cords) was taken from dead trees, cull trees, limbwood, trees less than 5 inches d.b.h., and trees on other than commercial forest land (fig. 32); most of this was used as fuelwood and chemical wood.

FIGURE 30.—*Decking logs at Cliffs-Dow Chemical Company woodyard, Marquette, Mich. Defective logs such as these are the principal source of chemical wood. About 70 percent of the wood consumed comes from logging operations in the form of bolts, cull logs, or split cordwood; the remaining 30 percent is in the form of sawmill slabs, veneer cores, etc. (Photo courtesy of Cliffs-Dow Chemical Co.)*

Aspen was cut more heavily than any other species—545,000 cords, representing 25 percent of the total. As a group, softwoods accounted for 30 percent of the cut and hardwoods 70 percent. Three-fifths of the timber cut was from sawtimber-size trees (appendix table 20). With heavy cuts of second-growth timber in recent years (especially aspen), the poletimber-to-sawtimber ratio has increased.

Lumber logs and bolts for sawmills ranked as the largest single drain item. These two closely related items made up 42 percent of the cut from growing stock. Pulpwood was second, accounting for 35 percent; fuelwood was third with 11 percent. Veneer logs, mine timbers, posts, excelsior, and other products made up the remaining 12 percent. The percentage of timber cut from sawtimber and poletimber trees by forest product in 1954 was as follows:

	Total (million cu. ft.)	Sawtimber trees (percent)	Poletimber trees (percent)
Lumber	74.5	89.7	10.3
Pulpwood	62.2	28.6	71.4
Fuelwood	19.1	62.0	38.0
Other	21.6	63.0	37.0
Total	177.4	62.0	38.0

Logging residue left in the woods and at landings or lost in transit amounted to nearly 19 million cubic feet (235,000 cords). About 80 percent was from sawtim-

ber trees, including 30 million board feet of saw log material and 125,000 cords of rough material in upper stems. Residue from poletimber trees was about 50,000 cords. Utilization was generally better for softwood species than for most hardwood species, probably because much of the hardwood material is low grade and of marginal value.

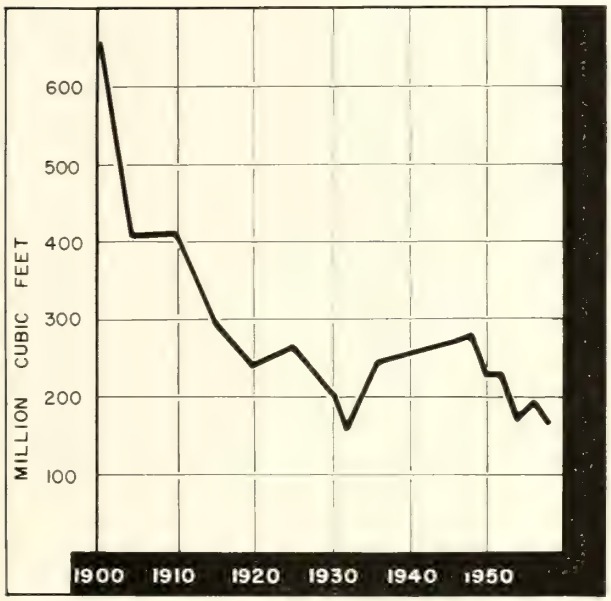


FIGURE 31.—*Trend in total timber removed, 1900-1958.*

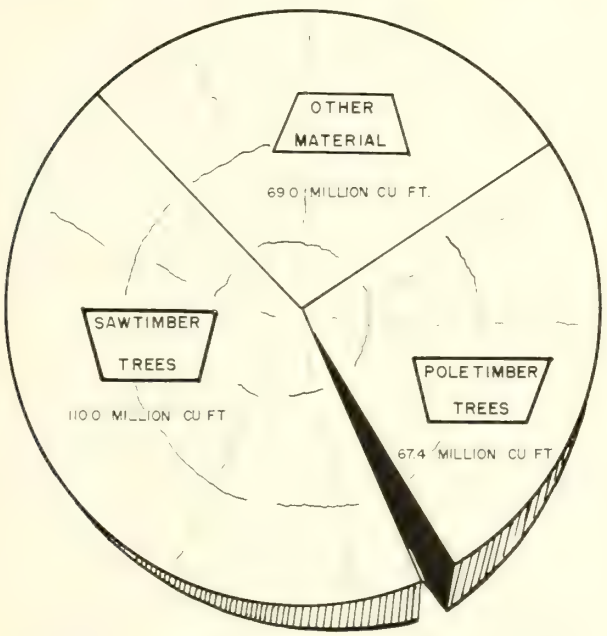


FIGURE 32.—*Kinds of timber cut in Michigan, 1954.*

Upper Peninsula of Michigan Furnishes Nearly Two-thirds of Cut

Cutting was heaviest in the Upper Peninsula, where 112 million cubic feet of timber were cut (fig. 33). Sixty-three percent of all growing stock cut came from this area, including 85 percent of the softwoods and 53 percent of the hardwoods.

The ratio of the 1954 cut to the inventory shows some significant variations in different parts of the State. The cut of softwood species was 3.3 percent of the softwood inventory in the west half of the Upper Peninsula. The cut in each of the three remaining districts was 1.5 percent. In the better hardwoods the cut in the west half of the Upper Peninsula was 2.4 percent, in the east half of the Upper Peninsula 2.0 percent, in the south half of the Lower Peninsula 1.3 percent, and in the north half of the Lower Peninsula 0.7 percent. These rough comparisons indicate that cutting in relation to the supply of standing timber was heaviest in the west half of the Upper Peninsula, especially in hemlock, spruce, and balsam, and lightest in the north half of the Lower Peninsula.

These cutting ratios are not static but fluctuate over a short period of years. Since 1954 the cut of hemlock

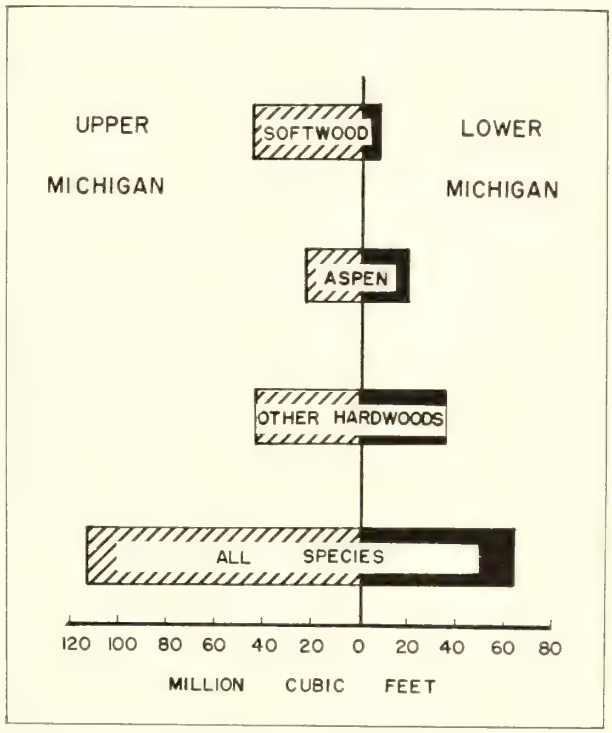


FIGURE 33.—*Timber cut from Upper and Lower Peninsulas of Michigan, by species group, 1954.*

and pine has dropped off sharply in the west half of the Upper Peninsula. A larger proportion of softwoods is now obtained from other parts of the State. Cutting of jack pine especially has been stepped up in the eastern Upper Peninsula and the north half of the Lower Peninsula.

Bulk of Timber Cut from Private Lands

Industrial, farm, and other private owners, with about three-fourths of the commercial forest area, supplied 84 percent of the timber cut in 1954 (appendix table 21). Private lands yielded about 90 percent of the lumber logs and veneer logs, and 68 percent of the pulpwood. Other products cut predominantly from private lands were fuelwood, fence posts, poles, and piling. Federal lands yielded about 9 percent of the 1954 cut, State lands 7 percent, and county lands less than 1 percent.

More Timber Products Cut Than Local Plants Process

Michigan's forest industries consumed less wood in 1954 than was cut from local forests. About 143 million cubic feet (1,786,000 cords) were cut as rough products for plants using logs and bolts, but Michigan plants consumed only 108 million cubic feet, equivalent to approximately 1,350,000 cords (fig. 34). Exports of logs and bolts to Wisconsin and other States amounted to 46 million cubic feet in contrast to imports of 11 million cubic feet.

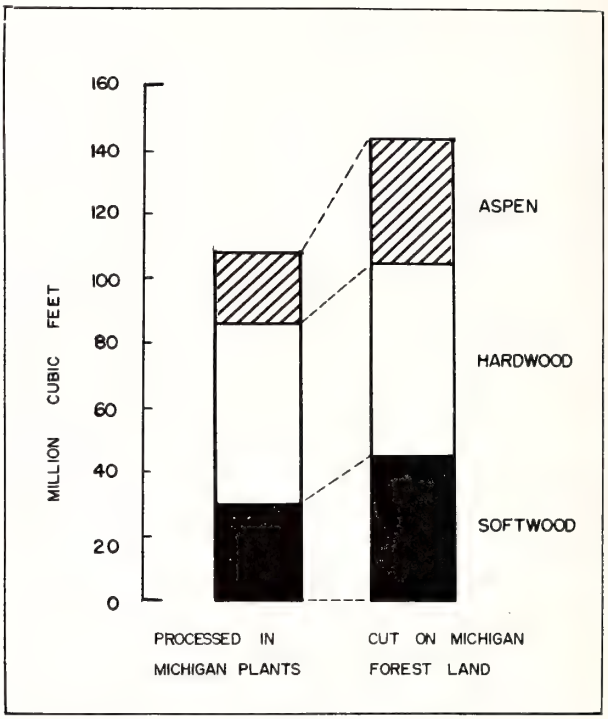


FIGURE 34.—*More logs and bolts were cut in 1954 than were used in Michigan plants.*

Toward A High Level of Sustained Yield

The prime objective of forest management is to create conditions that will result in a sustained flow of forest products at the highest and most efficient level of production. It is to this end that each of the aspects of the forest—history, area, volume, growth, and harvests—are carefully considered in terms of what is known about forest development. By comparing these factors, foresters can calculate the amount of timber that can and should be harvested in order to direct factors of the forest toward harmony with each other. The resulting statistic is called "allowable cut." This is briefly defined as the volume of live merchantable timber that can be cut during a given period while building up or maintaining sufficient growing stock to meet specified growth goals. Current allowable cut for all growing stock is 276.4 million cubic feet, including 757.2 million board feet of sawtimber (appendix table 22).

Hardwood species comprise 72 percent of the allowable cut from growing stock and 69 percent of that from sawtimber. The allowable cut by species group is as follows:

	Growing stock (million cu. ft.)	Sawtimber (million bd. ft.)
Allowable cut:		
Softwoods	78.1	232.7
Northern hardwoods	47.6	211.2
Aspen	72.7	76.0
Other hardwoods	78.0	237.3
Total	276.4	757.2

Almost three-fifths of the allowable cut of both sawtimber and poletimber is in the two Upper Peninsula districts (appendix table 23). The remaining two-fifths of the sawtimber allowable cut is fairly evenly divided between the two southern districts. Nearly 40 percent of the pulpwood allowable cut is in northern Lower Michigan (appendix table 24).

Allowable Cut Less Than Growth

The total growth exceeds allowable cut by 216.2 million cubic feet (appendix table 25). The growth estimate alone, however, does not provide a good indication of how much timber should be cut, for two reasons: First, much of the growth is occurring in seedling and sapling stands, most of it on trees that were not merchantable at the time of the survey but will become merchantable during the following 10 years. To build a large area of young stands toward a desirable size-class distribution, the cut must be less than growth. This is a dominant factor in Michigan where over 65 percent of the forested area is in poletimber and other young growth. Secondly, in the northern hardwoods type, for example, which contains a large volume of overmature timber, net growth is small in relation to total volume. These stands are unbalanced, with a large volume of old trees of low vigor that contribute little net growth. During the time that these old trees are being removed, the cut in such stands should exceed growth.

Eventually, as stand composition and size-class distribution improve, allowable cut will approach growth. Good management of Michigan's timber is necessary to attain this goal.

Timber Cut Can Be Increased in Some Species

The timber actually cut in 1954 was only about 64 percent of the volume recommended as allowable cut. Obviously the timber cut could be increased (appendix table 25).

The most notable differences between allowable cut and actual cut exist in the hardwood species—aspen, elm, oak, paper birch, soft maple, and miscellaneous hardwoods. Although much of the surplus is in small or poor-quality trees, much is suitable for pulping. Even though some northern hardwood species are overcut, incomplete utilization is taking place on pole-size and poor-quality trees. These trees, unless harvested, will seriously interfere with good-quality growing stock growth. But better-quality northern hardwood trees are generally being cut more heavily than is desirable.

Annually, 212 million board feet of sawtimber that could be cut is left as uncut surplus:

	Allowable cut (million bd. ft.)	Actual cut 1954 (million bd. ft.)
Softwoods:		
Red and white pine	48	21
Jack pine	24	11
Hemlock	76	78
Other softwoods	85	45
Total	233	155
Hardwoods:		
Northern hardwoods	212	219
Oak	68	40
Elm-ash-cottonwood	78	47
Soft maple	40	27
Aspen-birch	94	50
Other hardwoods	32	-
Total	524	390
All species	757	545

In other words, the actual sawtimber cut could be increased more than one-third. Of the surplus, 38 percent is in the Upper Peninsula, 35 percent in northern Lower Michigan, and 27 percent in southern Lower Michigan (appendix table 26). However, since about a third of the sawtimber is in nonsawtimber stands, some of the sawtimber allowable cut will not be available except in conjunction with pulpwood or improvement operations. Harvesting these trees will benefit the stands by providing more growing space for the younger trees.

The actual cut of pulpwood species was 484,000 cords less than the allowable cut.

	Allowable cut (thousand cords)	Actual cut 1954 (thousand cords)
Pulpwood species:		
Jack pine	135	61
Spruce	133	111
Balsam fir	165	144
Hemlock	201	198
Aspen	909	545
Total	1,543	1,059

Three-fourths of the surplus is in aspen, most of which is in northern Lower Michigan (appendix table 27). Of the softwood pulp species, jack pine has the most surplus. Although State totals show a surplus for each of the pulp species, some are being overcut within some of the districts. Actual harvests of balsam fir, spruce, and hemlock exceeded that calculated as desirable in the western Upper Peninsula. However, fluctuations in annual timber cut often offset heavy cutting in full production years to some extent.

In spite of these surpluses of allowable cut over harvest, markets have been improving. Since 1955 two new mills and one converted pulpmill have begun operating in Michigan, and many of the present mills are expanding capacity. Mill receipts increased from 454,600 cords in 1955 to 549,300 cords in 1958, an increase of 21 percent, and 1958 was a low year. Thus, inroads have been made into the surplus, and from all indications pulpwood demand will continue to increase, further reducing the gap between actual and allowable cut.

Forest Land Use and Management Practices

Many different conclusions could be drawn from the voluminous data in this report, depending upon the interests, assumptions, and viewpoints of the reader. It is possible to take considerable satisfaction in the progress made during the last 20 years, while at the same time being concerned about the possibility of meeting future needs for timber and other products of the forests. Because of the rapid changes taking place, predictions of future progress in forest development are difficult. Although we have estimates clearly showing the magnitude of future timber requirements, we cannot tell to what extent the forest resources will be built up to the point where they will meet these needs. The picture is complicated by the rising intensity of competition among various forest land uses.

Some of the coming changes in forest land use are obvious, and their effect can be evaluated. One thing we can be sure of is increased pressure on forest land for nonforest uses, such as highways, airports, urban development, and agriculture. For the most part these uses are essential and will inevitably decrease the forest area. This conversion is proceeding now, particularly in the southern part of Lower Michigan where cities and towns are expanding into the surrounding country. The movement takes out of production some good agricultural cropland. Long-range forecasts indicate that much more land than is now used will be required for food crops. This seems like a faraway prospect in view of current efforts to reduce the acreage tilled and return some land to grass and trees. But planning for future timber needs requires that we take a long-range view, for timber cannot be produced in a decade or two. The extra land needed for future crops will come largely from farm woodlots, bottomlands, and other areas now in trees. The production of timber from these lands will be lost and must be replaced.

Added to the uses that take land out of timber production are those that can be made compatible with growing trees, such as camping, fishing, hunting, and other forms of forest recreation. Except in rare cases and on relatively small areas, these uses need not inhibit timber development. The long-range need for timber production, coupled with inevitable withdrawals of forest land for other uses, makes it plain that great efforts are needed to get the most in timber and other goods and services from the forests that will remain.

How do present forest trends compare with projected needs? The past 20 years have brought many positive improvements. Growing stock and growth have increased and the stands have become better stocked on the average. Planting of denuded and idle forest lands has increased, and protection systems—especially fire protection—have become organized. Even greater improvements can be expected if the present trend of forestry effort continues. Will this be enough?

Men influence the growth of a forest in two basic ways: by protection, and by cutting. Except for the idle areas planted, improved forest conditions since 1936 are more the result of protecting what was there and letting it grow than of using the best cutting methods. This statement does not detract from the excellent silviculture practiced on some lands in all ownerships. But it does apply to the majority of forest land in Michigan. In the future, more stands will be influenced by scientific cutting to improve the quantity and quality of the residual growing stock.

Timber cutting with conscious effort to improve future productivity is mostly confined to the public forests and industrial forest ownerships. This includes about 48 percent of the commercial forest area, a good-sized part of the whole. Because of the continuity of policy so necessary in forest development, which spans many years, efforts to increase the growth of high-quality timber on public and industrial lands can be expected to pay off in the long run, assuring a large part of the future timber supply needs.

The needed efforts include more intensive silviculture applied to more land area, better access to outlying timber, development of markets for little-used species and low-quality trees in all areas, and new markets for good-quality trees in areas needing more cutting, such as the eastern Upper Peninsula. The administrators of large forest holdings, for the most part, have long-range plans for the orderly improvement of their properties. The progress in executing these plans will be influenced by the development of new markets and by the emphasis given to increased forest production by the public and the industrial owners.

The rest of the timber needed for future use will have to come from other ownerships where cutting is often uncontrolled and where timber production is usually a secondary use. A large proportion of this acreage is made up of farm woodlands and other small private ownerships under 5,000 acres which, together, account for half of all the State's commercial forest land. Efforts to increase the productivity of these lands will have to be sharpened to put the emphasis where the chances of future returns are best. Educational efforts of State extension foresters, county agricultural agents, and forest industry groups such as the Forest Industries Information Committee, play an important role in making small owners forestry conscious. Direct technical assistance in forest management is furnished by the State Division of Forestry and by certain individual companies. The federal cost-sharing provisions of the Agricultural Conservation Program provide a stimulus for tree planting and timber stand improvement where such practices may not otherwise be economically feasible.

Continued research is necessary to find better ways for growing, manufacturing, and marketing timber and timber products. Improved manufacturing methods and plant operation, market development, and improved marketing practices are necessary to both the small primary processors and to woodland owners.

The present surplus of allowable cut over actual cut in some species indicates room for expansion in the wood-using industries, particularly those industries that utilize cordwood-size material. The high losses to insects and disease suggest that cutting is not directed so as to remove a large part of the overmature or decadent trees. Timber stand improvement measures, such as release, thinning, and removal of cull and poor-risk trees, are badly needed but are practiced on only a small fraction of the forest area. With over 3 million acres of nonstocked forest land, it is obvious that the planting job ahead is still a very large one. To achieve full productivity from the land, increased planting as well as increased cutting is indicated.

While the future of Michigan's forests is much brighter than it was 20 years ago, much remains to be done. The forests are capable of producing more and better wood than they are now growing, and the wood will be needed. More timber production means more jobs, more products, and more prosperity for Michigan citizens.

Appendix

Forest Survey Methods

Statistics resulting from this second survey have previously been presented in county or block reports published by the Michigan Conservation Department. In this report statistics for some of the counties canvassed early in the survey have been adjusted to make all figures representative of the year 1955. The eight counties in the western Upper Peninsula were thus adjusted. Data for the Muskegon-Saginaw and the southwest Michigan blocks, although from the early part of the survey, were not revised. It was felt that changes in these two blocks were not as significant as those in the Upper Peninsula. A resurvey made in six counties in the Cadillac and Baldwin Blocks yielded new resource statistics which were substituted for earlier estimates. Also, a recent plantation survey provided some new pine-type area figures for the northern Lower Peninsula.

Adjustments also had to be made in the statistics for the 1935 survey, as survey methods have changed since that time.

Mortality and sawtimber-quality estimates came from a special study made in 1953.

The methods used to obtain the 1955 estimates given in this report are described below.

Area

The proportion of forest and nonforest area in most of Michigan was measured with a dot grid on alternate aerial photos. Each dot was classified as forest or nonforest. A portion of these dots was checked on the ground to confirm or correct the accuracy of the photo classification.

The division of forest area by condition classes was done in two ways:

RANDOM BLOCK SAMPLING.—In the Upper Peninsula and the northern Lower Peninsula, area estimates were based upon sample blocks selected at random. In Marquette County 640-acre and 40-acre sample blocks were used. For all other counties only 40-acre blocks were employed.

Where relatively new aerial photos were available, as in the eastern Upper Peninsula, all forest land on each of the sample blocks was photo-interpreted as to forest type, stand-size, and density. Eighteen blocks per township were thus photo-interpreted. A portion of these was then checked on the ground to confirm or correct the photo-classification. The changes made as a result of the ground check were extended to correct the photo-classification of the sample blocks that were not ground-checked.

Where photographs were old, photo-interpretation was kept to a minimum. The photos were used only for general purposes, such as locating the blocks and mapping type boundaries. Actual classification had to be done on the ground. The intensity of sample for these areas was nine 40-acre blocks per township.

DOT-SAMPLING.—A dot-sampling system was used in the sparsely forested southern Lower Michigan district. A portion of the dots used to determine the proportion of forest and nonforest area was further examined under the stereoscope and classified as to type, size, and density. Next a sample of the stereo-examined points was selected and checked in the field; these ground checks were then used to adjust the data on the samples that were not ground-checked.

The Forestry Division of the Michigan Department of Conservation used a block-sampling method on State forest land. Nine 25-acre blocks per township were selected mechanically and used as a base for determining forest area by condition class.

On all national-forest lands detailed forest type maps were made.

Ownership

Information on forest area and timber ownership was obtained from the county tax rolls.

Volume and Growth

Volume and growth measurements were obtained by taking 12,022 one-fifth acre circular plots on the ground-checked samples. These plots supplied the distribution of volume by species and diameter classes within each mapped condition class. The resulting volumes and growth per acre by condition class multiplied by area gave total volume and growth by species and diameter class.

Allowable Cut

Allowable cut represents the volume of timber that can be removed annually over a 10-year period while maintaining or building towards a desirable level of growing stock. It does not equal the volume that would be available under intensive forest management, but it does anticipate a management level somewhat higher than now exists. It assumes forest protection and management aimed toward a sustained yield on all forest lands. It implies good forest practices such as salvage and intermediate cuts and planned, controlled harvests.

Where the forest land is not well managed and consequently is either overcut or undercut, the allowable cut varies considerably from the amount actually removed. Nevertheless, allowable cut is a valuable guide for planning and evaluating progress in improving the management of the timber resource.

The appraisal of allowable cut was made as systematically as possible to reduce bias and insure uniformity.

Desirable intermediate and harvest cuts in mature uneven-aged stands and intermediate cuts in even-aged stands were determined on the sample plots as they were taken in the field. Field judgment, based upon such factors as operability and silvicultural treatment, was used to determine whether a stand was to be cut. All cuts were kept within the limits of practicable operations. Only cuts of at least 1,500 board feet or 3 cords per acre or a combination of the two equal to 3 cords were considered operable and included in the allowable cut calculations.

Calculating the harvest cuts in even-aged stands involved partial area control. It was provided for in the following basic formula:

$$HC = \frac{V}{n} + \frac{G}{2}$$

Where HC = annual harvest cut
V = volume of timber in the mature size class
G = annual growth of the mature size class
n = liquidation period of the mature size class

In some cases the largest size class would be exhausted in less than 10 years, making it necessary that part of the next smaller size class be cut; this was provided for in the formula:

$$HC = \frac{n}{10}\left(\frac{V}{n} + \frac{G}{2}\right) + \frac{10 - n}{n}\left(\frac{V' + G'\left(\frac{n + 10}{2}\right)}{n'}\right)$$

Where V′ = volume of timber in the smaller size class
G′ = annual growth of the next smaller size class
n′ = liquidation period of the next smaller size class

The liquidation period was determined by setting up a harvest range for each even-aged type. The lower limit of the harvest range was the average minimum age required to produce the desired products. The upper limit was the average maximum age that overmature timber could be held without appreciable losses. The liquidation period of any size class was dependent upon the desired size-class distribution and the harvest range. Under strict area control:

$$n = p \frac{R}{100}$$

Where n = liquidation period.
p = the percent of the type area covered by the size class
R = the optimum rotation age as determined by the mean site quality and the products desired.

The minimum liquidation period or the shortest possible time in which to begin harvesting the next lower size class was:

$$n_1 = R_1 - Ar$$

Where n_1 = the minimum liquidation period
R_1 = the lower limit of the harvest range
Ar = the upper limit of the age of the next smaller size class

The maximum liquidation or the longest period of time to which harvesting the next lower size class could be deferred was:

$$n_2 = R_2 - Ar$$

Where n_2 = the maximum liquidation period
R_2 = the upper limit of the harvest range
Ar = the upper limit of the age of the next smaller size class

Because size class adjustment within the even-aged types was the primary goal, the rigid area control (n) was used only when it fell between the two extremes (n_1 and n_2). If it fell below the minimum, the minimum was used. If it fell above the maximum, the maximum was used.

Timber Cut

All sawmills, pulp mills, veneer mills, and other wood-using industries were canvassed by mail or personal interviews to get an estimate of the amount of wood produced as primary forest products. Other surveys were made to estimate the amount of fuelwood and fence post production. Studies were also made of timber residues to adjust the production by commodities to timber cut in terms of inventory volumes. In addition, all public agencies were canvassed for the amount of wood sold during the year of survey and this information used to break down the total cut by ownership.

Accuracy of Survey

Area

There were two sources of error in estimating the area of forest land: (1) errors in classifying the type, size, and stocking classes and in compiling the data, and (2) sampling errors. A special effort was made to keep all errors of classification and measurement, in both field and office, to a mimimum. The degree of human errors cannot be measured. Statistical errors, which vary with sampling procedures, were kept as low as available funds would permit. The sampling intensity was sufficient to provide an estimate of the forest area with a standard error of about 0.33 percent or 1.4 percent per million acres.

Volumes

The sources of error in estimating timber volume include: (1) errors in measuring plot radius, tree diameter, height, and cull; (2) improper construction or use of tree volume tables; (3) errors in collecting or compiling the plot data; and (4) sampling errors. As in the area determinations, efforts were made to minimize the effect of such errors through continuous supervision and training. The number of volume plots taken in the State was sufficient to provide a standard error for total volume of 0.7 percent or 2.1 percent per billion cubic feet.

For any one type, species, ownership, or condition class the sampling error is considerably higher. Generally the smaller the area or volume, the higher the sampling error.

Definition of Terms

Land Use Classes

FOREST LAND AREA.—Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting influence on the climate or on the water regime, (b) land from which the trees described in (a) have been removed to less than 10 percent stocking and which has not been developed for other use; and (c) afforested areas. (Forest tracts of less than 1 acre, isolated strips of timber less than 120 feet wide, and abandoned fields and pastures not yet 10 percent stocked are excluded.)

COMMERCIAL FOREST LAND AREA.—Forest land that is (a) producing or physically capable of producing usable crops of wood (usually sawtimber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization.

NONCOMMERCIAL FOREST LAND AREA.—Forest land (a) withdrawn from timber utilization through statute, ordinance, or administrative order, but that otherwise qualifies as commercial forest land; or (b) incapable of yielding usable wood products (usually sawtimber or pulpwood) because of adverse site conditions.

NONFOREST LAND.—Land less than 10 percent stocked with trees and currently showing signs of use for purposes other than the growing of trees.

Forest Types

A forest type is characterized by the predominance of certain key species. Predominance means that in sawtimber stands 50 percent or more of the saw log volume is of the key species; in poletimber stands, 50 percent or more of the cordwood volume; and in seedling and sapling stands, 50 percent or more of the small trees. However, each type contains some transitional areas in which no species makes up 50 percent. In these places the classification is based upon species with the majority volume or number.

WHITE PINE TYPE.—Fifty percent or more of the stand is eastern white pine (common associates include red pine, jack pine, and aspen).

RED PINE TYPE.—Fifty percent or more of the stand is red pine (common associates include eastern white pine, jack pine, and aspen).

JACK PINE TYPE.—Fifty percent or more of the stand is jack pine (common associates include eastern white pine, red pine, and aspen).

BLACK SPRUCE TYPE.—Swamp conifer forest stand in which 50 percent or more of the stand is black spruce (common associates include tamarack, balsam fir, and white-cedar).

TAMARACK TYPE.—Swamp conifer forest stand in which 50 percent or more of the stand is tamarack (common associates include black spruce and white-cedar).

CEDAR TYPE.—Swamp conifer forest stand in which 50 percent or more of the stand is white-cedar (common associates include balsam fir, black spruce, and tamarack).

SPRUCE-FIR TYPE.—A mixed hardwood-conifer stand

in which 50 percent or more of the stand is white spruce and balsam fir, singly or in combination (common associates include black spruce, white-cedar, American elm, aspen, red maple, and paper birch).

NORTHERN HARDWOOD TYPE.—Fifty percent or more of the stand is sugar maple, yellow birch, beech, and basswood, singly or in combination (common associates include American elm, red oak, aspen, red maple, and paper birch).

ELM-ASH-COTTONWOOD (BOTTOMLAND) HARDWOOD TYPE.—Fifty percent or more of the stand is black ash, green ash, American elm, slippery elm, and cottonwood, singly or in combination (common associates include red maple, basswood, and aspen).

OAK-HICKORY TYPE.—Fifty percent or more of the stand is oaks or hickory, singly or in combination (common associates include basswood and American elm). May be subtyped "scrub oak" if the type is capable of producing only fuelwood material.

ASPEN-BIRCH TYPE (OR ASPEN TYPE).—Fifty percent or more of the stand is trembling or large-tooth aspen, balsam poplar, and paper birch, singly or in combination (common associates include jack pine, balsam fir, and white spruce). May be subtyped as "paper birch" if that species is most common, or as "off-site aspen" if the type is not capable of producing sound merchantable pulpwood.

Species Group

SOFTWOODS.—Includes white pine, red pine, jack pine, white spruce, black spruce, balsam fir, tamarack, northern white-cedar, and hemlock.

HARDWOODS.—Consists of all commercial deciduous species including the aspens, unless otherwise specified.

NORTHERN HARDWOODS.—Includes sugar maple, yellow birch, beech, and basswood.

Stand-Size Classes

SAWTIMBER STANDS.—Stands with sawtimber trees having a minimum net volume per acre of 1,500 board feet, International 1/4-inch rule.

POLETIMBER STANDS.—Stands that fail to meet the sawtimber-stand specification but that are at least 10 percent stocked with poletimber and larger (5.0 inches and larger) trees, and with at least half the minimum volume in poletimber trees. (Poletimber stands carry at least 240 cubic feet per acre.)

SEEDLING AND SAPLING STANDS.—Stands not qualifying as either sawtimber or poletimber stands, but having at least 10 percent stocking of trees of commercial species and with at least half the minimum stocking in seedling and sapling trees.

NONSTOCKED.—Lands qualifying as forest but failing to meet the specifications for sawtimber, poletimber, or restocking stands. May include grass and brush areas.

Tree Classification

SAWTIMBER TREES.—Trees of commercial species that contain at least one merchantable saw log and that are of the following minimum diameters at breast height (d.b.h.): softwoods 9.0 inches, and hardwoods 11.0 inches. Merchantable saw logs are at least 8.0 inches in diameter inside bark at the small end, from 8 to 16 feet in length, and suitable for sawing into standard lumber, construction timbers, or ties. In 1935, 10-inch hardwoods were included in sawtimber if they contained a 16-foot No. 3 log or an 8-foot No. 2 log. Softwoods and aspen were estimated to a 6-inch top in 1935.

POLETIMBER TREES.—Trees of commercial species that meet regional specifications of soundness and form and are in the following d.b.h. range: softwoods, 5.0 to 8.9 inches; hardwoods, 5.0 to 10.9 inches. Such trees usually become sawtimber trees if left to grow.

SEEDLINGS AND SAPLINGS.—Trees of commercial species below 4.9 inches d.b.h.

CULL TREES.—Live trees of sawtimber or poletimber size, unmerchantable for saw logs now or prospectively because of defect, rot, or species. Excepted are trees of pulp species, such as black spruce, which do not normally grow to saw log size and are not culled if they are of a quality suitable for pulping.

Diameter Measurements

DIAMETER AT BREAST HEIGHT (D.B.H.).—Tree-stem diameter in inches measured outside bark at 4.5 feet above the ground level.

DIAMETER CLASS.—Trees grouped into 2-inch diameter classes, each class including diameters 0.9 inch above and 1.0 inch below the midpoint of the class—e.g., the 6-inch class would include trees having diameters from 5.0 to 6.9 inches d.b.h.

Volume Classification

ALL TIMBER VOLUME.—Net volume in cubic feet of live and salvable dead sawtimber trees and poletimber trees of commercial species and cull trees of all species from stump to a minimum 4.0-inch top diameter inside bark. Includes bole only of softwoods and both bole and limbs of hardwoods to a minimum 4.0-inch diameter inside bark.

LIVE ALL-TIMBER VOLUME.—Net volume in cubic feet of live sawtimber trees and live poletimber trees of commercial species, and cull trees of all species.

SAWTIMBER VOLUME.—Net volume in board feet, International ¼-inch rule, of live sawtimber trees. Minimum top diameter is 8.0 inches.

CORDWOOD VOLUME.—Net volume in poletimber trees or upper stems of sawtimber trees measured in 4- by 4- by 8-foot cords containing approximately 80 cubic feet of peeled wood.

GROWING STOCK VOLUME.—Net volume in cubic feet of central stem of live sawtimber trees and live poletimber trees from stump to a minimum merchantable 4.0-inch diameter. Excludes dead trees, cull trees, and hardwood limbs.

PULPWOOD VOLUME.—The total growing-stock volume of black spruce, white spruce, balsam fir, jack pine, hemlock, and aspen.

LOG GRADES.—*Specifications for log grades are as follows:*

Grade factors	Grade 1				Grade 2			Grade 3
	Hardwood (except aspen)		Red and white pine	Aspen	Hardwood (except aspen)	Red and white pine	Aspen	All species
	Butts only	Butts and uppers						
Diameter (minimum) small end of log....inches....	[1]13	[1]16	16	9	[1]11	12	9	8
Length (minimum).....feet....	10	10	10	8	8	10	8	[2]5
Clear cuttings (on the 3 best faces): [3]								
Length (minimum).....do....	7	5	.....	.....	3	.....	.....	2
Number on face.....	2	2	.....	.....	2	.....	.....	([4])
Yield in face length (each of 3 faces).....	5/6	5/6	3/4	4/4	4/6	1/2	.....	3/6
Yield in face length (each of 2 faces).....	.....	.....	.....	.....	.....	3/4	4/4	.....
Sweep and crook deduction (maximum)...percent...	15	15	.....	.....	30	.....	.....	50
Total defect, including sweep (maximum)....do....	40	40	25	0	50	50	30	60

[1] For basswood and ash, drop 1 inch in d. i. b.: 12, 15, and 10.

[2] Only 5 feet merchantable length is required except in a 1-bolt tree where a minimum of 8 feet is required.

[3] *Ties and timber logs* are not graded on a "cutting" basis. They will be graded 2 or 3, depending on diameter and length specifications. The following minimum rules apply to both grades 2 and 3. Sound knots are permitted if diameter of the knot collar (flush with surface of the log) is not more than ⅓ of log diameter at that point; whorls or grouped knots are allowed if their aggregate collar diameters occurring within a 6-inch vertical distance do not exceed ⅓ of the log diameter at that point; and any number of sound defects of any size are permitted if they can be slabbed off. No unsound internal defect is permitted, and sweep, in inches, must not exceed ¼ d. i. b. at small end of the log.

[4] Unlimited.

Sources: From Hardwood Log Grades for Standing Timber, U. S. Forest Prod. Lab., Rpt. D-1737, 60 pp., 1949; Interim Specifications for Ties, Timbers, or Construction Material (unpublished), U. S. Forest Serv., 1948; and Official Grading Rules for Northern Hardwood and Softwood Logs, Northern Hemlock and Hardwood Mfrs. Assn., 12 pp., 1943. (Softwood Log Grades of Prime, No. 1 and No. 2 correspond to Log Grades No. 1, No. 2, and No. 3 above respectively.)

Growth

NET ANNUAL GROWTH.—The change in net volume of sawtimber or growing stock on commercial forest land during a specified year.

INGROWTH.—The total volume of all trees that during the year or period reached minimum diameter for poletimber (5.0 inches); or for sawtimber (9.0 inches for softwoods and 11.0 inches for hardwoods).

Mortality of Growing Stock

The net cubic-foot volume removed from growing stock on commercial forest land during a specified period through death from natural causes. Also includes the loss of volume from increase in percentage of defect in the trees and stands with advancing age.

Allowable Cut

The volume of live sawtimber and poletimber that can be cut during a given period while building up or maintaining sufficient growing stock to meet specified growth goals. For methodology see page 32.

Timber Cut

ANNUAL CUT OF GROWING STOCK.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging, or by land clearing and cultural operations, on commercial forest land during a specified year.

ANNUAL CUT OF SAWTIMBER.—The net board-foot volume of live sawtimber trees cut or killed by logging, and by land clearing and cultural operations, on commercial forest land during a specified year.

TIMBER PRODUCTS OUTPUT.—The volume of timber products cut from growing stock and other sources.

LOGGING RESIDUES.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging on commercial forest land and not converted to timber products.

LAND CLEARING AND CULTURAL OPERATIONS.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by land clearing in a specified year and not converted to timber products.

Principal Commercial Forest Trees Recorded on the Michigan Forest Survey

SOFTWOODS

Summarized as—	*Tallied as—*	*Botanical name*
	White pine	*Pinus strobus*
	Red pine	*P. resinosa*
	Jack pine	*P. banksiana*
	Black spruce	*Picea mariana*
	White spruce	*P. glauca*
	Balsam fir	*Abies balsamea*
	Tamarack	*Larix laricina*
	White-cedar	*Thuja occidentalis*
	Hemlock	*Tsuga canadensis*

HARDWOODS

Sugar maple	Sugar maple	*Acer saccharum*
	Black maple	*A. nigrum*
	Yellow birch	*Betula alleghaniensis*
Soft maple	Red maple	*Acer rubrum*
	Silver maple	*A. saccharinum*
	Basswood	*Tilia americana*
	Beech	*Fagus grandifolia*
Elm	American elm	*Ulmus americana*
	Slippery elm	*U. rubra*
	Rock elm	*U. thomasii*
Red oak	Red oak	*Quercus rubra*
	Jack oak	*Q. ellipsoidalis*
	Black oak	*Q. velutina*
	Pin oak	*Q. palustris*
White oak	White oak	*Q. alba*
	Swamp white oak	*Q. bicolor*
	Bur oak	*Q. macrocarpa*
Aspen	Trembling aspen	*Populus tremuloides*
	Bigtooth aspen	*P. grandidentata*
	Cottonwood	*P. deltoides*
	Paper birch	*Betula papyrifera*
Ash	Black ash	*Fraxinus nigra*
	White ash	*F. americana*
Other hardwoods	Black cherry	*Prunus serotina*
	Balsam poplar	*Populus balsamifera*
	Hackberry	*Celtis occidentalis*
	Hickory	*Carya spp.*
	Black walnut	*Juglans nigra*
	Butternut	*J. cinerea*
	Willow	*Salix spp.*
	Boxelder	*Acer negundo*
	Ironwood	*Ostrya virginiana*
	Sassafras	*Sassafras albidum*
	Honeylocust	*Gleditsia triacanthos*
	Black locust	*Robinia pseudoacacia*
	Tulip poplar	*Liriodendron tulipifera*
	Sycamore	*Platanus occidentalis*
	Blackgum	*Nyssa sylvatica*

TABLE 1.—*Land areas, by major classes of land and forest survey district, Michigan, 1955*
(Thousand acres)

Class of land	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Forest:					
Commercial	19,121	4,291	4,748	7,508	2,574
Noncommercial:					
Reserved [1]	338	47	198	30	63
Unproductive [2]	240	70	55	113	2
Total	19,699	4,408	5,001	7,651	2,639
Nonforest:					
Farm	13,429	361	273	2,463	10,332
Other [3]	3,366	244	298	622	2,202
Total	16,795	605	571	3,085	12,534
All land	36,494	5,013	5,572	10,736	15,173

[1] Land in Federal, State, or county reserves where cutting of timber is prohibited by law or regulations.

[2] Poor swamp and other more or less wooded land judged incapable of producing merchantable pulpwood or sawtimber within 100 years.

[3] Includes 175,500 acres of water according to Survey standards of area classification but defined by the Bureau of Census as land.

TABLE 3.—*Commercial forest area, by forest type and forest survey district, Michigan, 1955*
(Thousand acres)

Forest type	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Softwood:					
White pine	186	56	51	66	13
Red pine	432	107	33	274	18
Jack pine	1,004	260	84	639	21
Spruce-fir	734	280	337	113	4
Black spruce	388	189	152	47	0
Tamarack	130	53	26	36	15
Cedar	886	445	159	274	8
Total	3,760	1,390	842	1,449	79
Hardwood:					
Northern hardwood	4,651	1,082	2,087	1,099	383
Oak-hickory	1,789	16	21	1,035	717
Ash-elm-cottonwood	974	96	64	259	555
Aspen-birch	4,799	1,102	1,122	2,218	357
Total	12,213	2,296	3,294	4,611	2,012
Nonstocked	3,148	605	612	1,448	483
All types	19,121	4,291	4,748	7,508	2,574

TABLE 2.—*Stand-size class and stocking density on commercial forest land, by forest survey district, Michigan, 1955*

Stand-size class	Total		Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
	Thousand acres	Percent	Thousand acres	Thousand acres	Thousand acres	Thousand acres
Large sawtimber stands	1,165	6	251	259	104	551
Small sawtimber stands	1,844	10	526	486	397	435
Poletimber stands	6,119	32	1,535	1,241	2,798	545
Seedling & sapling stands:						
Medium to well stocked	5,323	28	1,108	1,808	1,994	413
Poorly stocked	1,522	8	266	342	[767	147
Nonstocked	3,148	16	605	612	1,448	483
All stands	19,121	100	4,291	4,748	7,508	2,574

TABLE 4.—*Commercial forest land, by forest type and stand-size class, Michigan, 1955*
(Thousand acres)

Forest type	Total	Sawtimber stands	Poletimber stands	Seedling & sapling stands
Softwood:				
White pine	186	96	35	55
Red pine	432	60	68	304
Jack pine	1,004	31	350	623
Spruce-fir	734	56	320	358
Black spruce	388	6	157	225
Tamarack	130	2	36	92
Cedar	886	84	427	375
Total	3,760	335	1,393	2,032
Hardwood:				
Northern hardwood	4,651	1,566	1,361	1,724
Oak-hickory	1,789	486	673	630
Ash-elm-cottonwood	974	463	341	170
Aspen-birch	4,799	159	2,352	2,288
Total	12,213	2,674	4,727	4,812
Nonstocked	3,148			
All types	19,121	3,009	6,120	6,844

TABLE 6.—*Commercial forest land, by ownership and forest survey district, Michigan, 1955*
(Thousand acres)

Ownership class	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Federally owned or managed:					
National forest	2,410	775	826	800	9
Indian	21	5	14	1	1
Bureau of Land Management	9	4	3	2	0
Other	90	82	0	2	6
Total federal	2,530	866	843	805	16
State	3,695	1,116	680	1,780	119
County and municipal	85	3	51	20	11
Private:					
Farm	3,841	477	321	1,615	1,428
Other private:					
Large holdings (over 5,000 acres)	2,851	845	1,727	279	0
Small holdings (5,000 acres and less)	6,119	984	1,126	3,009	1,000
Total private	12,811	2,306	3,174	4,903	2,428
All ownerships	19,121	4,291	4,748	7,508	2,574

TABLE 5.—*Commercial forest land, by ownership and stand-size class, Michigan, 1955*
(Thousand acres)

Ownership	All land	Total forest	Sawtimber stands	Poletimber stands	Seedling & sapling stands	Non-stocked
Federally owned or managed:						
National forest	2,549	2,410	217	761	1,259	173
Indian	27	21	2	4	13	2
Bureau of Land Management	15	9	1	2	4	2
Other	265	90	9	25	16	40
Total federal	2,856	2,530	229	792	1,292	217
State	4,226	3,695	393	1,333	1,292	677
County or municipal	129	85	13	24	37	11
Private:						
Farm	17,270	3,841	842	1,116	1,044	839
Other private:						
Large holdings (over 5,000 acres)	2,979	2,851	681	859	1,028	283
Small holdings (5,000 acres and less)	9,034	6,119	851	1,995	2,152	1,121
Total private	29,283	12,811	2,374	3,970	4,224	2,243
All ownerships	36,494	19,121	3,009	6,119	6,845	3,148

TABLE 7.—*Net volume of all timber of commercial forest land, by class of material, forest survey district, and species group, Michigan, 1955*

(Million cubic feet)

Class of material	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Growing stock:					
Sawtimber trees:					
Saw log portion	3,662	861	1,124	704	970
Upper stem portion	994	238	304	193	259
Total	4,656	1,102	1,428	897	1,229
Poletimber trees	6,057	1,454	1,519	2,302	782
Total	10,713	2,556	2,947	3,199	2,011
Other material:					
Sound cull trees	601	452	700	374	108
Rotten cull trees	1,033				
Total	1,634	452	700	374	108
Hardwood limbs	478	87	126	93	172
Salvable dead trees	12	3	4	2	3
Total	490	90	130	95	175
Total all timber	12,837	3,098	3,777	3,668	2,294

TABLE 8.—*Net volume of sawtimber and growing stock on commercial forest land, by species, Michigan, 1955*

Species	Growing stock	Sawtimber
	Million cu. ft.	Million bd. ft.
Softwoods:		
White pine	294	1,199
Red pine	156	571
Jack pine	310	384
Spruce	337	702
Balsam fir	415	577
Tamarack	68	65
Cedar	575	1,010
Hemlock	439	1,891
Total	2,594	6,399
Hardwoods:		
Sugar maple	1,471	4,182
Yellow birch	348	1,194
Basswood	337	788
Beech	266	996
Elm	825	2,598
Red oak	760	2,012
White oak	385	972
Aspen	1,779	1,174
Cottonwood	29	135
Paper birch	438	460
Soft maple	769	1,474
Ash	280	503
Hickory	50	115
Black walnut	12	37
Other hardwoods	370	718
Total	8,119	17,358
All species	10,713	23,757

TABLE 9.—*Net volume of live sawtimber on commercial forest land, by species and forest survey district, Michigan, 1955*

(Million board feet)

Species	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Softwoods:					
White pine	1,199	374	427	310	88
Red pine	571	229	74	268	*
Jack pine	384	107	56	221	*
Spruce	702	275	390	37	*
Balsam fir	577	192	322	61	2
Tamarack	65	35	18	6	6
Cedar	1,010	445	455	97	13
Hemlock	1,891	724	1,011	141	15
Total	6,399	2,381	2,753	1,141	124
Hardwoods:					
Sugar maple	4,182	995	2,283	320	584
Yellow birch	1,194	405	752	30	7
Basswood	788	60	192	228	308
Beech	996	457	16	251	272
Elm	2,598	159	155	733	1,551
Red oak	2,012	17	122	676	1,197
White oak	972	*	*	192	780
Aspen	1,174	241	440	447	46
Cottonwood	135	0	0	30	105
Paper birch	460	267	148	42	3
Soft maple	1,474	337	267	192	678
Ash	503	31	76	109	287
Other hardwoods	870	208	43	178	441
Total	17,358	3,177	4,494	3,428	6,259
All species	23,757	5,558	7,247	4,569	6,383

* Less than ½ of 1 recognizable unit.

TABLE 10.—*Net volume of live sawtimber on commercial forest land, by diameter class and species, Michigan, 1955*

(Million board feet)

Species	Total	Diameter class (inches)					
		10	12	14	16	18	20+
Softwoods:							
White pine	1,199	200	268	171	170	102	288
Red pine	571	149	124	146	78	30	44
Jack pine	384	202	120	28	7	27	0
Spruce	702	246	207	100	66	48	35
Balsam fir	577	348	178	39	7	3	2
Tamarack	65	30	17	10	7	1	0
Cedar	1,010	331	276	197	95	50	61
Hemlock	1,891	193	312	312	217	216	641
Total	6,399	1,699	1,502	1,003	647	477	1,071
Hardwoods:							
Sugar maple	4,182	—	928	885	761	639	969
Yellow birch	1,194	—	224	292	216	130	332
Basswood	788	—	229	182	111	110	156
Beech	996	—	172	232	222	122	248
Elm	2,598	—	489	498	344	314	953
Red oak	2,012	—	558	521	280	316	337
White oak	972	—	238	267	196	129	142
Aspen	1,174	—	775	243	109	18	28
Cottonwood	135	—	3	1	2	25	104
Paper birch	460	—	226	118	69	37	10
Soft maple	1,474	—	438	330	209	214	283
Ash	503	—	148	136	95	74	51
Hickory	115	—	27	56	13	10	9
Black walnut	37	—	8	7	8	5	9
Other hardwoods	718	—	229	236	113	76	64
Total	17,358	—	4,692	4,004	2,748	2,219	3,695
All species	23,757	1,699	6,194	5,007	3,395	2,696	4,766

TABLE 11.—*Net volume of cordwood material on commercial forest land, by species, Michigan, 1955*
(Million cubic feet)

Species	Total	Poletimber	Tops of sawtimber trees
Softwoods:			
White pine	102	51	51
Red pine	64	39	25
Jack pine	249	229	20
Spruce	224	185	39
Balsam fir	323	291	32
Tamarack	57	53	4
Cedar	414	364	50
Hemlock	137	61	76
Total	1,570	1,273	297
Hardwoods:			
Sugar maple	835	678	157
Yellow birch	167	121	46
Basswood	217	185	32
Beech	113	72	41
Elm	431	327	104
Red oak	455	371	84
White oak	238	196	42
Aspen	1,601	1,548	53
Cottonwood	8	3	5
Paper birch	368	347	21
Red maple	544	489	55
Ash	204	183	21
Other hardwoods	300	264	36
Total	5,481	4,784	697
All species	7,051	6,057	994

TABLE 12.—*Volume of principal pulpwood species by forest survey district, Michigan, 1955*
(Thousand cords)

Species	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Softwoods:					
Jack pine	3,880	1,110	480	2,290	*
Spruce	4,210	2,040	1,810	360	*
Balsam fir	5,190	2,240	2,170	760	20
Hemlock	5,480	2 040	2,830	560	50
Total	18,760	7,430	7,290	3,970	70
Aspen	22,240	3,860	6,340	10,700	1,340
All pulp species	41,000	11,290	13,630	14,670	1,410

* Less than 5,000 cords.

TABLE 13.—*Net volume of growing stock and live sawtimber on commercial forest land, by ownership class and species group, Michigan, 1955*

Ownership class	Growing stock			Sawtimber		
	Total	Softwoods	Hardwoods	Total	Softwoods	Hardwoods
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Federally owned or managed:						
National forest	1,273	444	829	2,487	1,015	1,472
Indian	10	2	8	16	4	12
Bureau of Land Management	4	1	3	8	3	5
Other	31	11	20	54	24	30
Total federal	1,318	458	860	2,565	1,046	1.519
State	1,569	567	1,002	2,882	1,187	1,695
County and municipal	53	10	43	126	29	97
Private:						
Farm	2,349	248	2,101	5,630	534	5,096
Other private:						
Large holdings (over 5,000 acres)	2,016	743	1,273	5,922	2,122	3,800
Small holdings (5,000 acres and less)	3,408	568	2,840	6,632	1,481	5,151
Total private	7,773	1,559	6,214	18,184	4,137	14,047
All ownerships	10,713	2,594	8,119	23,757	6,399	17,358

TABLE 14.—*1935 and 1955 growing stock and sawtimber volume in Upper and Lower Michigan, by species group*

Species	Total volume			Upper Michigan			Lower Michigan		
	1935	1955	Change	1935	1955	Change	1935	1955	Change
Growing stock:	Million cu. ft.	Million cu. ft.	Percent	Million cu. ft.	Million cu. ft.	Percent	Million cu. ft.	Million cu. ft.	Percent
Pine	450	760	+ 69	257	411	+ 60	193	349	+ 81
Hemlock	1,528	439	— 71	1,469	393	— 73	59	49	— 17
Other softwoods	1,651	1,395	— 16	1,521	1,149	— 24	130	246	+ 89
Northern hardwoods[1]	3,716	2,422	— 35	3.228	1,635	— 49	488	787	+ 61
Aspen, cottonwood	826	1,808	+119	403	816	+102	423	992	+135
Other hardwoods	2,229	3,889	+ 74	860	1,102	+ 28	1,369	2,787	+104
All species	10,400	10,713	+ 3	7,738	5,503	— 29	2,662	5,210	+ 96
Sawtimber:	Million bd. ft.	Million bd. ft.	Percent	Million bd. ft.	Million bd. ft.	Percent	Million bd. ft.	Million bd. ft.	Percent
Pine	1,250	2,154	+ 72	875	1,267	+ 45	375	887	+136
Hemlock	6,191	1,891	— 69	6,011	1,735	— 71	180	156	— 13
Other softwoods	2,241	2,354	+ 5	2,132	2,132	0	109	222	+104
Northern hardwoods[1]	12,180	7,160	— 41	10,886	5,160	— 53	1,294	2,000	+ 55
Aspen, cottonwood	476	1,309	+175	274	681	+149	202	493	+144
Other hardwoods	3,924	8,889	+127	1,627	1,830	+ 12	2,297	7,194	+213
All species	26,262	23,757	— 10	21,805	12,805	— 41	4,457	10 952	+146

[1] Sugar maple, yellow birch, beech, and basswood.

TABLE 15.—*Net annual growth of growing stock, sawtimber, and poletimber on commercial forest land by species, Michigan, 1955*

Species	Growing stock	Sawtimber	Poletimber
	Million cu. ft.	Million bd. ft.	Thousand cords
Softwoods:			
White pine	10.3	47.8	7.6
Red pine	8.3	32.4	21.1
Jack pine	32.7	88.0	161.9
Spruce	15.6	43.1	78.6
Balsam fir	29.6	66.2	191.8
Tamarack	5.9	9.2	48.3
Cedar	24.7	49.3	179.5
Hemlock	6.8	31.9	5.2
Total	133.9	367.9	694.0
Hardwoods:			
Sugar maple	50.8	81.8	441.6
Yellow birch	5.9	15.1	38.4
Basswood	13.7	42.4	69.2
Beech	4.6	23.8	*
Elm	31.1	126.2	85.5
Red oak	27.8	92.6	122.4
White oak	18.6	48.3	114.5
Aspen	108.5	146.6	994.6
Cottonwood	.4	2.6	—.5
Paper birch	20.6	26.6	192.3
Soft maple	40.8	82.3	315.2
Ash	14.3	30.9	104.5
Other hardwoods	21.6	52.0	146.2
Total	358.7	771.2	2,623.9
All species	492.6	1,139.1	3,317.9

* Less than ½ of 1 recognizable unit.

TABLE 16.—*Annual net growth on commercial forest land by species and district, Michigan, 1955 (Cords)*[1]

Species	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Softwoods:				
White pine	54,500	32,300	27,300	14,500
Red pine	40,000	17,300	46,400	0
Jack pine	100,000	38,500	268,800	1,600
Spruce	95,900	77,800	21,100	100
Balsam fir	185,000	122,900	62,300	400
Tamarack	32,100	11,600	26,800	3,200
Cedar	126,300	61,300	116,100	5,000
Hemlock	26,600	37,800	19,700	800
Total	660,400	399,500	588,500	25,600
Hardwoods:				
Sugar maple	155,000	240,300	193,900	46,000
Yellow birch	13,500	45,700	11,000	4,100
Basswood	16,400	42,700	74,300	37,500
Beech	17,600	4,700	17,100	18,200
Elm	35,400	21,900	125,400	205,300
Red oak	5,800	10,800	212,900	117,100
White oak	*	*	104,000	128,800
Aspen	269 600	395,700	534,800	155,300
Cottonwood	*	*	400	5,200
Paper birch	95,500	51,100	97,700	13,800
Red maple	107,100	124,000	150,600	128,400
Ash	24,300	12,300	83,000	59,600
Other hardwoods	43,200	35,200	92,600	99,300
Total	783,400	984,400	1,697,700	1,018,600
All species	1,443,800	1,383,900	2,286,200	1,044,200

[1] Standard survey cord of 80 cubic feet of solid wood.
* Signifies less than 50 cords.

TABLE 17.—*Estimated annual mortality of sawtimber and growing stock, by species group, Michigan, 1955*

Species group	All growing stock	Sawtimber
	Million cu. ft.	Million bd. ft.
Softwoods:		
Pine	5	12
Spruce and fir	9	17
Hemlock	3	20
Tamarack and cedar	7	12
Total	24	61
Hardwoods:		
Northern hardwoods[1]	15	64
Aspen	45	62
Other hardwoods	28	91
Total	88	217
All species	112	278

[1] Sugar maple, yellow birch, beech, and basswood.

TABLE 18.—*Number of primary wood-using plants, by forest survey district, Michigan, 1954*

Kind of mill	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Sawmills:					
Large[1]	11	1	10	0	0
Medium[2]	85	14	35	17	19
Small	1,866	314	320	574	658
Total	1,962	329	365	591	677
Pulp mills	11	4	1	2	4
Veneer mills:					
Standard grade	4	2	1	1	0
Container	19	5	0	3	11
Excelsior mills	2	0	0	1	1
Chemical plants	2	0	2	0	0
Miscellaneous plants	100	20	15	40	25
Total	2,100	360	384	638	718

[1] Annual lumber output in excess of 5 million board feet.
[2] Annual lumber output from 1 million to 5 million board feet.

TABLE 19.—*Output of timber products and annual cut of live sawtimber and growing stock, Michigan, 1954*

Timber product	Output of timber products					Annual cut of sawtimber			Annual cut of growing stock		
	Volume in std. units		Roundwood volume								
	Unit	Number	Total	Softwood	Hardwood	Total	Softwood	Hardwood	Total	Softwood	Hardwood
			Thousand cu. ft.	Thousand cu. ft.	Thousand cu. ft.	Thousand bd. ft.	Thousand bd. ft.	Thousand bd. ft.	Thousand cu. ft.	Thousand cu. ft.	Thousand cu. ft.
Saw logs and saw bolts	M bd. ft.[1]	383,046	62,593	15,739	46,854	369,924	89,824	280,100	74,480	17,834	56,646
Veneer logs and bolts	M bd. ft.[1]	34,499	5,312	48	5,264	35,709	322	35,387	6,657	60	6,597
Pulpwood	Std. cords[2]	797,092	61,662	28,566	33,096	74,474	54,326	20,148	62,213	27,746	34,467
Fuelwood	Std. cords[2]	[3]1,058,200	75,127	3,891	71,236	33,644	0	33,644	19,123	58	19,065
Chemical wood	Std. cords[2]	[4] 125,655	9,173	0	9,173	6,699	0	6,699	1,931	0	1,931
Excelsior	Std. cords[2]	29,007	2,234	0	2,234	609	0	609	2,466	0	2,466
Piling	M linear ft.	337	254	12	242	1,686	80	1,606	303	14	289
Poles	M pieces	21	144	144	0	493	493	0	158	158	0
Posts	M pieces	6,737	5,355	4,746	609	2,913	2,823	90	4,178	4,024	154
Hewn ties	M pieces	41	62	40	22	242	144	98	76	48	28
Mine timbers	M cu. ft.	3,728	3,728	2,471	1,257	10,357	4,449	5,908	3,461	1,976	1,485
Miscellaneous[5]	M cu. ft.	1,881	1,881	606	1,275	7,926	2,183	5,743	2,355	714	1,641
Total			227,525	56,263	171,262	544,676	154,644	390,032	177,401	52,632	124,769

[1] International ¼-inch rule.
[2] Rough wood basis.
[3] Including 14,352 M cubic feet of wood from mill residue used for domestic and industrial fuel.
[4] Including 1,208 M cubic feet of wood from mill residue.
[5] Includes woodenware, handle stock, cabin logs, heading stock, lath or shingle bolts, etc.

TABLE 20.—*Timber cut of all growing stock, sawtimber, and poletimber on commercial forest land by species, Michigan, 1954*

Species	Net cut from—		
	Growing stock	Sawlogs	Poletimber trees
	Thousand cu. ft.	Thousand bd. ft[1]	Thousand cu. ft.
Softwoods:			
White pine	3,551	18,245	300
Red pine	481	2,407	52
Jack pine	4,896	11,463	2,488
Spruce	8,872	7,471	7,215
Balsam fir	11,521	25,345	5,820
Tamarack	876	1,890	491
Cedar	6,597	9,856	4,255
Hemlock	15,838	77,967	889
Total	52,632	154,644	21,510
Hardwoods:			
Sugar maple	30,151	140,800	2,775
Soft maples	6,731	26,880	1,353
Yellow birch	9,660	44,579	1,177
Basswood	2,442	12,632	111
Elm	9,769	37,756	2,041
Beech	4,826	20,738	660
Red oaks	8,253	33,454	1,475
White oaks	1,785	6,404	395
Aspen	43,588	43,702	33,660
Balsam poplar	41	193	5
Cottonwood	541	2,885	15
Paper birch	2,360	6,319	851
Ash	1,917	6,791	494
Hickory	1,980	4,795	634
Walnut	156	360	48
Other hardwoods	569	1,744	147
Total	124,769	390,032	45,841
All species	177,401	544,676	67,351

[1] Board feet International ¼-inch log scale.

TABLE 22.—*Annual allowable cut of growing stock, sawtimber, and poletimber on commercial forest land, by species, Michigan, 1955*

Species	Growing stock	Sawtimber	Poletimber
	Million cu. ft.	Million bd. ft.	Thousand cords
Softwoods:			
White pine	7.8	35.6	7
Red pine	2.9	12.0	5
Jack pine	10.8	24.3	71
Spruce	10.6	24.3	67
Balsam fir	13.2	22.9	103
Tamarack	1.6	3.0	11
Cedar	15.1	35.1	97
Hemlock	16.1	75.5	13
Total	78.1	232.7	374
Hardwoods:			
Sugar maple	24.5	109.1	48
Yellow birch	8.7	38.5	17
Basswood	5.1	21.0	13
Beech	9.3	42.6	14
Elm	14.6	62.0	34
Red oak	12.4	47.7	39
White oak	5.7	20.7	21
Aspen	72.7	76.0	722
Cottonwood	1.1	5.4	1
Paper birch	14.9	18.5	140
Soft maple	13.9	40.4	78
Ash	4.0	10.5	25
Other hardwoods	11.4	32.1	65
Total	198.3	524.5	1,217
All species	276.4	757.2	1,591

TABLE 21.—*Timber cut by ownership class, Michigan, 1954*

Land ownership class	All growing stock			Sawtimber			Pulpwood[1]	
	Softwoods	Hardwoods	Aspen	Softwoods	Hardwoods	Aspen	Softwoods	Aspen
	Cords[2]	Cords[2]	Cords[2]	Thousand bd. ft.	Thousand bd. ft.	Thousand bd. ft.	Cords[2]	Cords[2]
Federally owned or managed:								
National forest	57,038	51,650	96,600	12,179	19,112	5,119	51,713	96,600
Indian	13	288	0	4	42	0	0	0
Other	1,038	13	0	298	8	0	375	0
Total federal	58,089	51,951	96,600	12,481	19,162	5,119	52,088	96,600
State	59,700	18,188	71,763	10,516	6,890	4,884	55,325	71,763
County	2,650	2,700	400	931	1,054	18	2,163	400
Total public land	120,439	72,839	168,763	23,928	27,106	10,021	109,576	168,763
Private land	537,461	941,924	376,087	130,716	319,224	33,681	404,512	376,087
All commercial forest land	657,900	1,014,763	544,850	154,644	346,330	43,702	514,088	544,850

[1] Limited to principal pulp species, i.e., jack pine, spruce, balsam fir, hemlock, and aspen.
[2] Standard survey cord equivalent to 80 cubic feet of solid wood.

TABLE 23.—*Annual allowable cut of sawtimber and growing stock on commercial forest land, by species group and forest survey district, Michigan, 1955*

Class of material and species group	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Growing stock:					
Softwoods	78.1	35.5	24.2	17.4	1.0
Northern hard woods[1]	47.6	16.0	18.1	7.5	6.0
Aspen	72.7	16.9	14.9	36.1	4.8
Other hardwoods	78.0	18.6	6.7	26.3	26.4
Total	276.4	87.0	63.9	87.3	38.2
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Sawtimber:					
Softwoods	232.7	97.9	87.9	43.3	3.6
Northern hard-woods[1]	211.2	75.9	81.7	24.7	28.9
Aspen	76.0	21.3	20.0	30.2	4.5
Other hardwoods	237.3	44.9	15.0	65.2	112.2
Total	757.2	240.0	204.6	163.4	149.2

[1] Sugar maple, yellow birch, beech, and basswood.

TABLE 24.—*Annual allowable cut of principal pulpwood species, by forest survey district, Michigan, 1955*
(Thousand cords)

Species	Total	Eastern Upper Michigan	Western Upper Michigan	Northern Lower Michigan	Southern Lower Michigan
Softwoods:					
Jack pine	135	42	7	86	0
Spruce	133	75	45	13	0
Balsam fir	165	85	57	23	0
Hemlock	201	71	112	17	1
Total	634	273	221	139	1
Aspen	909	211	187	451	60
All pulp species	1,543	484	408	590	61

TABLE 25.—*Net annual growth, allowable annual cut, and actual 1954 cut by species, Michigan*
(Million cubic feet)

Species	Net annual growth	Allowable cut	Actual cut 1954
Softwoods:			
White pine	10.3	7.8	3.6
Red pine	8.3	2.9	.5
Jack pine	32.7	10 8	4.9
Spruce	15.6	10.6	8.9
Balsam fir	29.6	13.2	11.5
Tamarack	5.9	1.6	.9
Cedar	24.7	15.1	6.6
Hemlock	6.8	16.1	15.8
Total	133.9	78.1	52.7
Hardwoods:			
Sugar maple	50.8	24.5	30.2
Yellow birch	5.9	8.7	9.7
Basswood	13.7	5.1	2.4
Beech	4.6	9.3	4.8
Elm	31.1	14.6	9.8
Red oak	27.8	12.4	8.3
White oak	18.6	5.7	1.8
Aspen	108.5	72.7	43.6
Cottonwood	.4	1.1	.5
Paper birch	20.6	14.9	2.4
Soft maple	40.8	13.9	6.7
Ash	14.3	4.0	1.9
Other hardwoods	21.6	11.4	2.7
Total	358.7	198.3	124.8
All species	492.6	276.4	177.5

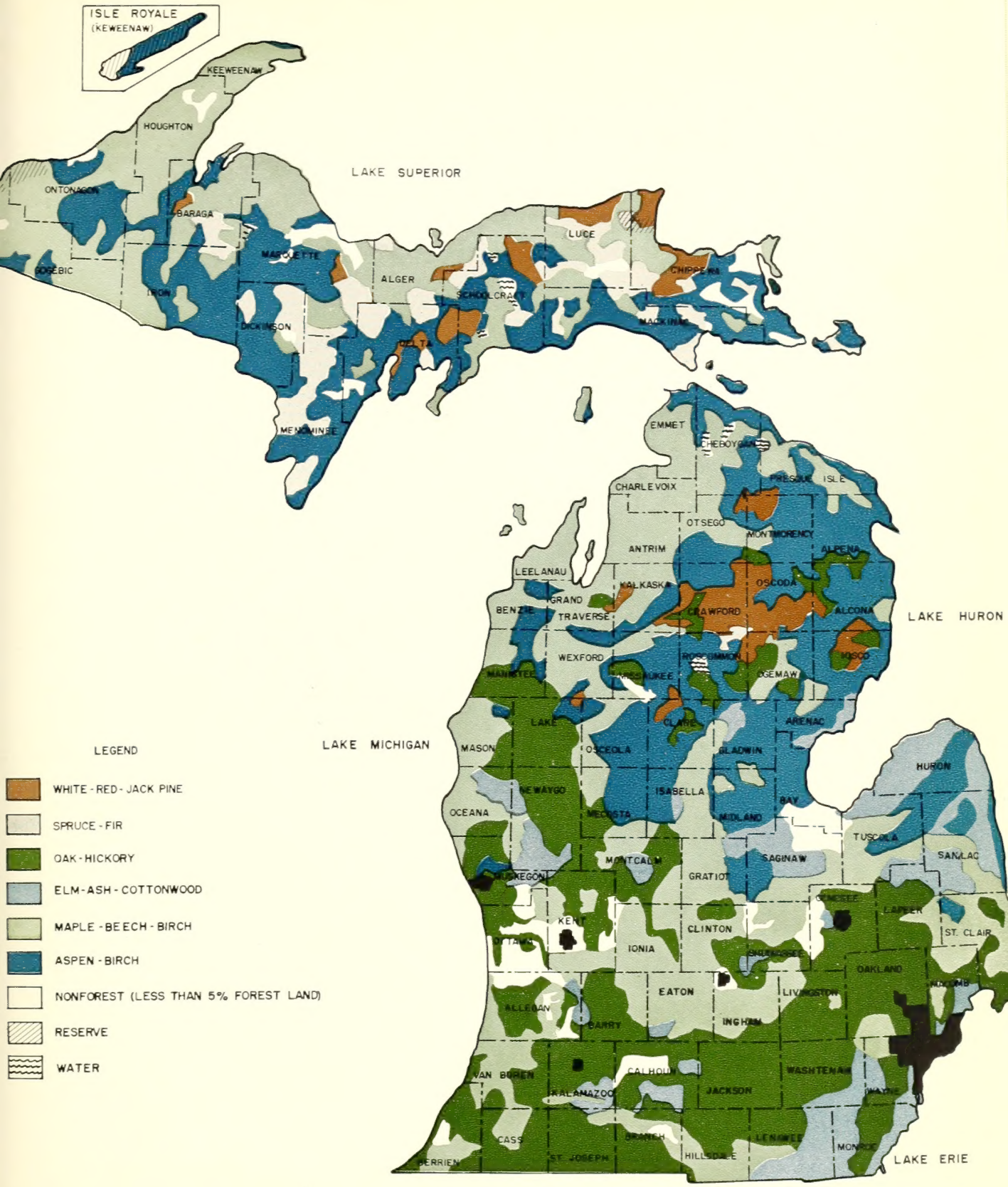
TABLE 26.—*Allowable cut and actual 1954 cut of sawtimber, by forest survey district and species group, Michigan*
(Million board feet)

Species group	Total		Eastern Upper Michigan		Western Upper Michigan		Northern Lower Michigan		Southern Lower Michigan	
	Allow-able cut	Actual cut, 1954	Allow-able cut	Actual cut, 1954	Allow-able cut	Actual cut, 1954	Allow-able cut	Actual cut, 1954	Allow-able cut	Actual cut, 1954
Softwoods:										
Red & white pine	48	21	20	4	13	11	12	4	3	2
Jack pine	24	11	6	1	1	0	17	10	0	0
Hemlock	76	78	28	17	42	59	5	2	1	0
Other softwoods	85	45	44	17	32	25	9	3	0	0
Total	233	155	98	39	88	95	43	19	4	2
Hardwoods:										
Northern hardwoods[1]	212	219	76	54	82	121	25	26	29	18
Oak	68	40	1	0	2	2	24	7	41	31
Ash, elm, cottonwood	78	47	7	3	2	8	26	12	43	24
Soft maple[2]	40	27	10	6	5	8	6	4	19	9
Aspen, birch	94	50	33	13	25	14	31	21	5	2
Other hardwoods	32	7	15	0	1	0	8	0	8	7
Total	524	390	142	76	117	153	120	70	145	91
All species	757	545	240	115	205	248	163	89	149	93

[1] Sugar maple, yellow birch, beech, and basswood.
[2] Red and silver maple.

TABLE 27.—*Allowable cut and actual 1954 cut for principal pulp species, by forest survey district, Michigan*
(Thousand cords)

Species	Total		Eastern Upper Michigan		Western Upper Michigan		Northern Lower Michigan		Southern Lower Michigan	
	Allowable cut	Actual cut, 1954	Allowable cut	Actual cut, 1954	Allowable cut	Actual cut, 1954	Allowable cut	Actual cut, 1954	Allowable cut	Actual cut, 1954
Softwoods:										
Jack pine	135	61	42	6	7	1	86	52	0	2
Spruce	133	111	75	41	45	67	13	3	0	0
Balsam fir	165	144	85	57	57	84	23	3	0	0
Hemlock	201	198	71	40	112	153	17	5	1	0
Total	634	514	273	144	221	305	139	63	1	2
Aspen	909	545	211	113	187	175	451	232	60	25
All pulp species	1,543	1,059	484	257	408	480	590	295	61	27



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